



UNIVERSITY OF JAMMU

(NAAC ACCREDITED 'A' GRADE UNIVERSITY)
(Baba Sahib Ambedkar Road, Jammu-180006 (J&K))

Academic Section

Email: academicsectionju14@gmail.com

NOTIFICATION

(24/ April/Adp./03)

It is hereby notified for the information of all concerned that the Vice-Chancellor, in anticipation of the approval of the Academic Council, is pleased to authorize the adoption of the Syllabi and Courses of Studies in the subject of **Zoology** of Semester Vth, VIth, VIIth and VIIIth for Four Year Under Graduate Programme FYUGP as per NEP-2020 (as given in the annexure) for the examinations to be held in the years as per the details given below:

Subject	Semester	For the examinations to be held in the year
Zoology	Semester-V	December 2024, 2025 and 2026
	Semester-VI	May 2025, 2026 and 2027
	Semester-VII	December 2025, 2026 and 2027
	Semester-VIII	May 2026, 2027 and 2028

The Syllabi of the courses are also available on the University website: www.jammuuniversity.ac.

Sd/-

DEAN ACADEMIC AFFAIRS

No. F. Acd/II/24/ 489-538

Dated: 11/4/24

Copy for information and necessary action to:

1. Dean Faculty of Life-Science
2. HOD/Convener, Board of Studies Zoology
3. Sr. P.A. to the Controller of Examinations
4. All members of the Board of Studies
5. Confidential Assistant to the Controller of Examinations
6. Director, Computer Centre, University of Jammu
7. Deputy Registrar/Asstt. Registrar (Conf. /Exams. UG)
8. Incharge University Website for necessary action please

Sumitasharma
Deputy Registrar (Academic) 8/4/2024
SS 8/4/24
Pal 8/4/24
7 08/4/24

**COURSE FRAMEWORK OF THE FOUR YEAR UNDERGRADUATE PROGRAMME (FYUGP)
UNDER NATIONAL EDUCATION POLICY (NEP-2020)
UNDERGRADUATE COURSE (ZOOLOGY)**

**PROPOSED COURSE SCHEME FOR SEMESTER-V
EXAMINATION TO BE HELD IN DEC 2024, DEC 2025, DEC 2026**

S.No.	COURSE TYPE	COURSE CODE	COURSE TITLE	CREDITS	MAXIMUM MARKS		
					Theory	Practical	Total
1.	Major	UMJZOT501	Life and Diversity of Non-Chordates	4	75	25	100
2.	Major	UMJZOT502	Molecular Biology	4	75	25	100
3.	Major	UMJZOT503	Animal Biotechnology	4	75	25	100
4.	Major	UMJZOT504	Human Genetics	2	50	-	50
5.	Minor	UMIZOT505	Non-Chordate Diversity	4	75	25	100
6.	Summer Internship	USEZOI506	Summer Internship	2	-	50	50

**PROPOSED COURSE SCHEME FOR SEMESTER-VI
EXAMINATION TO BE HELD IN MAY 2025, MAY 2026, MAY 2027**

S.No.	COURSE TYPE	COURSE CODE	COURSE TITLE	CREDITS	MAXIMUM MARKS		
					Theory	Practical	Total
1.	Major	UMJZOT601	Life and Diversity of Chordates	4	75	25	100
2.	Major	UMJZOT602	Economic Zoology	4	75	25	100
3.	Major	UMJZOT603	Animal Behaviour and Chronobiology	4	75	25	100
4.	Major	UMJZOT604	Biochemistry of Metabolic Processes	4	75	25	100
5.	Minor	UMIZOT605	Chordate Diversity	4	75	25	100

**COURSE FRAMEWORK OF THE FOUR YEAR UNDERGRADUATE PROGRAMME (FYUGP)
UNDER NATIONAL EDUCATION POLICY (NEP-2020)
UNDERGRADUATE COURSE (ZOOLOGY)**

**PROPOSED COURSE SCHEME FOR SEMESTER-VII
EXAMINATION TO BE HELD IN DEC 2025, DEC 2026, DEC 2027**

S.No.	COURSE TYPE	COURSE CODE	COURSE TITLE	CREDITS	MAXIMUM MARKS		
					THEORY	PRACTICAL	TOTAL
1.	Major	UMJZOT701	RESEARCH METHODOLOGY AND ETHICS	4	75	25	100
2.	Major	UMJZOT702	DEVELOPMENTAL BIOLOGY	4	75	25	100
3.	Major	UMJZOT703	BASIC ENDOCRINOLOGY	4	75	25	100
4.	Major	UMJZOT704	BIOSYSTEMATICS AND TAXONOMY	4	75	25	100
5.	Minor	UMIZOT705	BIOLOGICAL CLASSIFICATION AND SYSTEMATICS	4	75	25	100

**PROPOSED COURSE SCHEME FOR SEMESTER-VIII (HONOURS)
EXAMINATION TO BE HELD IN MAY 2026, MAY 2027, MAY 2028**

S.No.	COURSE TYPE	COURSE CODE	COURSE TITLE	CREDITS	MAXIMUM MARKS		
					THEORY	PRACTICAL	TOTAL
1.	Major	UMJZOT801	ICHTHYOLOGY	4	75	25	100
2.	Major	UMJZOT802	BIOINSTRUMENTATION	4	75	25	100
3.	Major	UMJZOT803	MICROBIOLOGY	4	75	25	100
4.	Major	UMJZOT804	COMPARATIVE ANATOMY OF VERTEBRATES	4	75	25	100
5.	Minor	UMIZOT805	FISH BIOLOGY AND DIVERSITY	4	75	25	100

**PROPOSED COURSE SCHEME FOR SEMESTER-VIII (HONOURS WITH RESEARCH)
EXAMINATION TO BE HELD IN MAY 2026, MAY 2027, MAY 2028**

S.No.	COURSE TYPE	COURSE CODE	COURSE TITLE	CREDITS	MAXIMUM MARKS		
					THEORY	PRACTICAL	TOTAL
1.	Major	UMJZOT806	BIOINSTRUMENTATION	4	75	25	100
2.	Minor	UMIZOT807	TOOLS AND TECHNIQUES IN BIOLOGY	4	75	25	100
3.	SEC	USEZOT808	DISSERTATION	12	-	-	300



University of Jammu
Syllabi of Zoology for FYUGP under CBCS as per NEP-2020

SEMESTER-V
(Examination to be held in 2024, 2025, 2026)

Major Course

Course Code: UMJZOT501

Course Title: Life and Diversity of Non-Chordates

Credits: 04 {03(Theory) + 01(Practical)}

Total no. of lectures: Theory: 45 hours

Practical: 30 hours

Maximum Marks: 100

Theory: 75

Practical/Tutorial: 25

Major Course

Course Code: UMJZOT502

Course Title: Molecular Biology

Credits: 04 {03(Theory) + 01(Practical)}

Total no. of lectures: Theory: 45 hours

Practical: 30 hours

Maximum Marks: 100

Theory: 75

Practical/Tutorial: 25

Major Course

Course Code: UMJZOT503

Course Title: Animal Biotechnology

Credits: 04 {03(Theory) + 01(Practical)}

Total no. of lectures: Theory: 45 hours

Practical: 30 hours

Maximum Marks: 100

Theory: 75

Practical/Tutorial: 25

Major Course

Course Code: UMJZOT504

Course Title: Human Genetics

Credits: 02

Total no. of lectures: Theory: 30 hours

Maximum Marks: 50

Theory/Practical: 50

Minor Course

Course Code: UMIZOT505

Course Title: Non-Chordate Diversity

Credits: 04 {03(Theory) + 01 (Practical)}

Total no. of lectures: Theory: 45 hours

Practical: 30 hours

Maximum Marks: 100

Theory: 75

Practical/Tutorial: 25

Summer Internship

Course Code: USEZOI506

Course Title: Summer Internship

Credits: 02

Maximum Marks: 50

UNIVERSITY OF JAMMU
SYLLABI AND COURSE OF STUDY IN ZOOLOGY UNDER CBCS AS
PER NEP - 2020

(For the Examination to be held in Year 2024, 2025 & 2026)

(MAJOR COURSE)

UG SEMESTER-V

MAJOR CORE COURSE NO.	:	UMJZOT501
MAJOR CORE COURSE TITLE	:	LIFE AND DIVERSITY OF NON-CHORDATES
CREDITS	:	04 {03 (Theory) + 01 (Practical)}
MAXIMUM MARKS	:	75
I) External (University Exam)	:	60
II) Internal Assessment	:	15
DURATION OF UNIVERSITY EXAM	:	03 Hours
MAXIMUM MARKS PRACTICALS	:	25
I) Continuous assessment	:	10
II) Final examination	:	15

Objectives and Expected Learning Outcomes

The course aims to provide undergraduate students with a comprehensive understanding of the diverse world of non-chordate animals, encompassing their structural organization, classification, functional adaptations, and evolutionary significance. Through a systematic exploration of key phyla such as Protozoa, Porifera, Coelenterata, Platyhelminthes, Aschelminthes, Annelida, Arthropoda, Mollusca, and Echinodermata, students will develop a strong foundation in non-chordate zoology, fostering the ability to recognize and appreciate the intricate mechanisms that have shaped these organisms and their ecosystems.

Unit 1: Introduction to Non-Chordate Zoology and Protozoa (10 hours)

- 1.1 Structural Organization and Classification
 - 1.1.1 Basis of classification in non-chordates
 - 1.1.2 Types of symmetry
- 1.2 Protozoa
 - 1.2.1 General characters and classification up to class level with examples
 - 1.2.2 Locomotion in Protozoa
 - 1.2.3 Nutrition in Protozoa
 - 1.2.4 Osmoregulation in Protozoa
 - 1.2.5 Habit-Habitat, External Morphology, Reproduction and Life History of *Paramecium*

Unit 2: Porifera and Coelenterata (10 hours)

- 2.1 Porifera
 - 2.1.1 General characters and classification up to class level with examples
 - 2.1.2 Histological elements and Skeleton system in Porifera
 - 2.1.3 Canal system in Porifera



2.1.4 Habit-Habitat, External Morphology, Reproduction and Life History of *Scypha* (*Sycon*)

2.2 Coelenterata

2.2.1 General characters and classification up to class level with examples

2.2.2 Habit-Habitat, External Morphology, Reproduction and Life History of *Metridium*

2.2.3 Polymorphism in Coelenterates

2.2.4 Coral reefs and types

Unit 3: Platyhelminthes, Aschelminthes, and Annelida

(12 hours)

3.1 Platyhelminthes

3.1.1 General characters and classification up to class level with examples

3.1.2 Habit-Habitat, External Morphology, Reproduction and Life History of the following platyhelminthes

3.1.2.1 *Taenia solium*

3.1.2.2 *Fasciola hepatica*

3.2 Aschelminthes

3.2.1 General characters and classification up to class level with examples

3.2.2 Habit-Habitat, External Morphology, Reproduction and Life History of *Ascaris lumbricoides*

3.3 Annelida

3.3.1 General characters and classification up to class level with examples

3.3.2 Habit-Habitat, External Morphology and Reproduction of the Earthworm

Unit 4: Arthropoda, Mollusca, and Echinodermata

(13 hours)

4.1 Arthropoda

4.1.1 General characters and classification up to class level

4.1.2 Metamorphosis and its types in Insects

4.1.3 Habit-Habitat, External Morphology, Nervous system and Reproduction of the Prawn

4.2 Mollusca

4.2.1 General characters and classification up to class level with examples

4.2.2 Habit-Habitat, External Morphology and Nervous system of *Pila globosa*

4.2.3 Torsion in Molluscs

4.3 Echinodermata

4.3.1 General characters and classification up to class level with examples

4.3.2 Echinoderm larvae and their significance

4.3.3 Water vascular system in *Asterias* (Starfish)

Practicum

(30 hours)

- Museum Specimens:** *Sycon*, *Euspongia*, *Euplectella*, *Hyalonema*, *Hydra*, *Obelia*, *Millepora*, *Tubularia*, *Sertularia*, *Physalia*, *Velella*, *Porpita*, *Aurelia*, Sea anemone, Corals, *Planaria*, *Fasciola*, *Schistosoma*, *Taenia*, *Ascaris*, *Ancylostoma*, *Nereis*, *Heteroneis*, *Aphrodite*, *Tubicola*, *Chaetopterus*, *Terebella*, *Serpula*, *Arenicola*, *Lumbricus*, *Pheretima*, *Hirudinaria*, *Pontobdella*, *Hirudo*, *Balanus*, *Lepas*, Crayfish, Prawn, hermit-crab, honey bee, cockroach, grasshopper, house fly, praying mantis, stick insect, dragon fly, *Lepisma*, termites, scorpion, spider, *Limulus*, Millipede, Centipede, *Pila*, *Chiton*, *Mytilus*, *Unio*, *Pecten*, pearl oyster, *Dentalium*, *Patella*, *Murex*, *Helix*, *Lymnaea*, *Planorbis*, *Loligo*, *Sepia*, *Octopus*, *Nautilus*, *Antedon*, *Asterias*, *Holothuria*,

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Echinus, Ophiothrix.

2. **Microscopic slides (Whole Mount):** *Euglena, Trypanosoma, Amoeba, Entamoeba, Leishmania, Giardia, Monocystis, Plasmodium, Paramecium, Vorticella*, L.S. and T.S. of *Sycon*, sponging spicules, sponging fibres and gemmules, *Hydra*
3. **Preparation of permanent stained mounts:** *Obelia*, Parapodium of *Nereis*, Nephridium of earth worm, Ovary of earthworm, Statocyst of prawn, Mouthparts and trachea of cockroach, mouth parts of mosquito.
4. A visit to Zoological Museum, Butterfly Park, Department of Zoology, University of Jammu.

NOTE FOR CONDUCTING PRACTICALS (MANDATORY)

Practicals to be conducted mandatorily in separate groups as per UGC guidelines (15-20 students per group) in addition to theory classes.

NOTE FOR PAPER SETTING

Examination Theory/Practical	Syllabus to be covered in Examination	Time allotted for Exam	Marks
Internal Theory Assessment	50%	1 Hr and 30 Min	15
External Theory End Semester	100%	3 Hrs	60
Continuous assessment	-	-	10 (Based on Daily Performance only)
Final examination	-	-	15

External End Semester Theory Examination will have two sections (A & B) {Total marks 60}
Section A: Four short answer questions representing all units/syllabi i.e., one question from each unit. Each question shall be of 3 marks.

Section B: Eight long answer questions (Four to be attempted) representing whole of the syllabi i.e., two questions from each unit. Each question shall be of 12 marks

Internal Assessment {Total marks 15}

Fifteen (15) marks for theory paper in a subject reserved for internal assessment shall have one long answer type question of 7 marks and four short answer type questions of 2 marks each.

Recommended Readings:

1. Ruppert and Barnes, R.D. (2006). Invertebrate Zoology, VIII Edition. Holt Saunders, International Edition.



2. Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. and Spicer, J.I. (2002). The Invertebrates: A New Synthesis, III Edition, Blackwell Science
3. Barrington, E.J.W. (1979). Invertebrate Structure and Functions. II Edition, E.L.B.S. and Nelson
4. Young J. Z. (2004). The Life of Vertebrates. III Edition. Oxford university press.
5. Pough H. Vertebrate life, VIII Edition, Pearson International.
6. Darlington P.J. The Geographical Distribution of Animals, R.E. Krieger Pub Co.
7. Hall B.K. and Hallgrimsson B. (2008). Strickberger's Evolution. IV Edition. Jones and Bartlett Publishers Inc.
8. Arora, Mohan P. (2006), Non-chordata – I, Himalaya Publishing House, Mumbai
9. Kotpal, R. L. (2020), Modern Text Book of Zoology: Invertebrates (12th Ed.), Rastogi Publications
10. Verma P. S. (2001) Invertebrate Zoology (Multicolour Edition) S. Chand & Co. Publishing



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SYLLABI AND COURSE OF STUDY IN ZOOLOGY UNDER CBCS AS
PER NEP - 2020
(For the Examination to be held in Year 2024, 2025 & 2026)
(MAJOR COURSE)
UG SEMESTER-V

MAJOR CORE COURSE NO.	:	UMJZOT502
MAJOR CORE COURSE TITLE	:	MOLECULAR BIOLOGY
CREDITS	:	04 {03 (THEORY) + 01 (Practical)}
MAXIMUM MARKS	:	75
I) External (University Exam)	:	60
II) Internal Assessment	:	15
DURATION OF UNIVERSITY EXAM	:	03 Hours
MAXIMUM MARKS PRACTICALS	:	25
I) Continuous Assessment	:	10
II) Final Examination	:	15

Objectives and Expected Learning Outcomes

The syllabus on Molecular Genetics aims to provide students with a comprehensive understanding of key molecular genetic concepts. By the end of the course, students will comprehend the historical context and significance of molecular biology, identify genetic material and the evidences supporting DNA and RNA as genetic material, describe the chemical composition and structures of DNA and RNA, elucidate DNA replication mechanisms, explain transcription, post-transcriptional modifications, and repair mechanisms, interpret the genetic code and protein synthesis process, grasp gene organization principles, comprehend gene regulation in prokaryotes and eukaryotes including transcriptional and post-translational controls, and recognize the role of regulatory RNAs in genetic regulation. Through these objectives, students will gain the ability to analyze, synthesize, and explain fundamental molecular genetic phenomena, fostering a solid foundation in the field.

Unit 1: Genetic Material and Molecular Biology

(12 hours)

- 1.1 Concept of Molecular Biology and historical background
- 1.2 Nucleic Acids
 - 1.2.1 Chemical composition and salient features of DNA and RNA
 - 1.2.2 Watson and Crick's Structural Model of DNA
 - 1.2.3 Types of DNA (A, B, C, D, Z, Single Stranded)
- 1.3 Evidences of DNA as the Genetic Material: Transformation, Transduction and Conjugation
- 1.4 Evidences of RNA as the Genetic Material

Unit 2: Biosynthesis of Nucleic Acids and Repair mechanisms

(12 hours)

- 2.1 DNA Replication
 - 2.1.1 Semiconservative mode of DNA replication



- 2.1.2 Unidirectional and Bidirectional DNA Replication
- 2.1.3 Semi-discontinuous DNA Replication
- 2.1.4 Role of RNA Primers in DNA Replication
- 2.1.5 Enzymes and proteins involved in DNA Replication
- 2.1.6 Mechanism of DNA replication
- 2.2 Transcription: Synthesis of RNA
 - 2.2.1 Mechanism of RNA transcription
 - 2.2.2 Post Transcriptional Modifications and Processing RNA:Capping,Polyadenylation and RNA Splicing
- 2.3 Concept of Reverse Transcription

Unit 3: Gene Organization and Translation

(10 hours)

- 3.1 The Genetic code
 - 3.1.1 Genetic code and its Characteristics
 - 3.1.2 Chain Initiation and Chain Termination Codons
 - 3.1.3 Wobble Hypothesis
- 3.2 Protein synthesis
 - 3.2.1 Protein Synthesis Apparatus
 - 3.2.1.1 tRNA structure and function
 - 3.2.1.2 Structural Assembly and composition of Ribosomes
 - 3.2.2 Steps involved in Protein Synthesis

Unit 4: Gene concept and Regulation of Gene action

(11 hours)

- 4.1 Gene
 - 4.1.1 Concept, Definition and Size
 - 4.1.2 Types of Genes: Split, overlapping and pseudogenes
 - 4.1.3 C-value Paradox
 - 4.1.4 Repetitive DNA
 - 4.1.5 Selfish genes
- 4.2 Gene regulation in prokaryotes
 - 4.2.1 Principles of transcriptional regulation
 - 4.2.1.1 Negative Control: Inducible (lac operon) and Repressible Systems
 - 4.2.1.2 Positive Control: Tryptophan operon
 - 4.2.1.3 Translational and post-translational control (Feedback inhibition)

Practicum

(30 hours)

1. Study of Watson and Crick's Structural Model of DNA through Models/Charts.
2. Study of structure of tRNA, rRNA and mRNA through charts/photographs.
3. Preparation of different types of buffers used in molecular biology (for DNA extraction and storage, Gel Electrophoresis, etc.)
4. Extraction of genomic DNA from *E.coli*/animal tissue/plant tissue.
5. Virtual Lab on extraction of DNA
 - <https://learn.genetics.utah.edu/content/labs/extraction/>
 - <https://vlab.amrita.edu/index.php?sub=3&brch=77&sim=218&cnt=1>
6. Agarose Gel electrophoresis of genomic DNA
7. Virtual Lab on Gel Electrophoresis of DNA
 - <https://learn.genetics.utah.edu/content/labs/gel>
 - <https://vlab.amrita.edu/index.php?sub=3&brch=77&sim=1375&cnt=2>



8. Quantitative estimation of DNA by diphenylamine reaction using colorimeter.
9. Study and interpretation of electron micrographs/ photograph showing (a) DNA replication (b) Transcription (c) Split genes
10. Hands-on activity translating codons to amino acids using the genetic code to emphasize the importance of the genetic code.
11. A visit to Central Facility and Molecular Lab. in Department of Zoology, University of Jammu.
12. A visit to Biotechnology park, J&K

NOTE FOR CONDUCTING PRACTICALS (MANDATORY):

Practicals to be conducted mandatorily in separate groups as per UGC guidelines (15-20 students per group) in addition to theory classes.

NOTE FOR PAPER SETTING

Examination Theory/Practical	Syllabus to be covered in Examination	Time allotted for Exam	Marks
Internal Theory Assessment	50%	1 Hr and 30 Min	15
External Theory End Semester	100%	3 Hrs	60
Continuous assessment	-	-	10 (Based on daily Performance only)
Final Examination	-	-	15

External End Semester Theory Examination will have two sections (A & B) (Total Marks 60)

Section A: Four short answer questions representing all units/syllabi i.e., one question from each unit. Each question shall be of 3 marks.

Section B: Eight long answer questions (Four to be attempted) representing whole of the syllabi i.e., two questions from each unit. Each question shall be of 12 marks.

Internal Assessment (Total Marks 15)

Fifteen (15) marks for theory paper in a subject reserved for internal assessment shall have one long answer type question of 7 marks and four short answer type questions of 2 marks each.

Recommended Readings:

1. Becker, W.M., Kleinsmith, L.J., Hardin, J. and Bertoni, G. P. (2009). The World of the Cell. VII Edition. Pearson Benjamin Cummings Publishing, San Francisco.
2. Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter: Molecular Biology of the Cell, IV Edition.
3. Cooper G. M. and Robert E. Hausman R. E. The Cell: A Molecular Approach, V Edition, ASM Press and Sinauer Associates.
4. De Robertis, E.D.P. and De Robertis, E.M.F. (2006). Cell and Molecular Biology. VIII Edition. Lippincott Williams and Wilkins, Philadelphia.



5. Karp, G. (2010) Cell and Molecular Biology: Concepts and Experiments. VI Edition. John Wiley and Sons. Inc.
6. Lewin B. (2008). Gene XI, Jones and Bartlett
7. McLennan A., Bates A., Turner, P. and White M. (2015). Molecular Biology IV Edition. GS, Taylor and Francis Group, New York and London.
8. Gupta P.K. Genetics. Rastogi Publicatins
9. David Freifelder. Molecular Biology. Jones & Bartlett Publishers
10. Watson J D, Baker T A, Bell S P, Gann A, Levine M and Losick R. (2014) Molecular Biology of the Gene, 6th edition, Cold Spring Harbour Lab. Press, Pearson Publication.
11. Alberts B and Jhonson A D. (2014) Molecular Biology of the Cell, 6th edition, Garland Science.
12. Krebs J, Goldstein E, Kilpatrick S. (2013) Lewin's Essential Genes, 3rd Ed., Jones and Bartlett Learning.
13. Gardner E J, Simmons M J, Snustad D P. (2008) Principles of Genetics. 8th Ed. Wiley-India.
14. Brown TA. (2007) Genomes-3. Garland Science Publishers.
15. Rastogi SC. (2012) Cell and Molecular Biology. New age international publication.



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(MAJOR COURSE)
UG SEMESTER-V

MAJOR CORE COURSE NO.	:	UMJZOT503
MAJOR CORE COURSE TITLE	:	ANIMAL BIOTECHNOLOGY
CREDITS	:	04 {03 (THEORY) + 01 (Practical)}
MAXIMUM MARKS	:	75
I) External (University Exam):	:	60
II) Internal Assessment	:	15
DURATION OF UNIVERSITY EXAM :	:	03 Hours
MAXIMUM MARKS PRACTICALS	:	25
I) Continuous Assessment	:	10
II) Final Examination	:	15

Objectives and Expected Learning Outcomes

The course in Animal Biotechnology aims to provide students with a comprehensive understanding of the fundamental concepts and practical techniques in the field. By the end of the course, students should be able to apply recombinant DNA technology for gene manipulation and amplification, cultivate animal cells and produce recombinant proteins, comprehend the methods for creating genetically modified organisms (GMOs) and transgenic animals, evaluate their diverse applications in biotechnology and agriculture, and understand the ethical and legal aspects of animal biotechnology. Additionally, students will be equipped to contribute to advancements in livestock and aquaculture through reproductive manipulation techniques and gain an awareness of the broader ethical and regulatory issues pertaining to genetic engineering in animals.

Unit 1: Animal Biotechnology: Concept and basic techniques (10 hours)

- 1.1 Overview and key concepts of Animal Biotechnology
- 1.2 Recombinant DNA Technology: Gene isolation, Manipulation and Amplification
 - 1.2.1 Restriction endonucleases, their types and characteristics
 - 1.2.2 Cloning Vectors: Basic Characteristics and types (Plasmids, Cosmids, Phagemids, Artificial Chromosome Vectors, Viral Vectors.
 - 1.2.3 Method of Recombinant/Chimeric DNA production
 - 1.2.4 Genomic and cDNA Libraries: Concept

Unit 2: Animal Tissue Culture (12 hours)

- 2.1 Historical background and development of Animal Cell Culture
- 2.2 Culture media
 - 2.2.1 Constituents of Culture media
 - 2.2.2 Types of Culture media: Natural and Synthetic



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- 2.3 Types of Animal Cell Culture
- 2.4 Cell Lines: Types, Nomenclature, Selection and Maintenance
- 2.5 Stem cells- Properties, Types, Applications and Challenges
- 2.6 Recombinant Vaccines
- 2.7 Production of Recombinant Proteins: Monoclonal Antibodies, Recombinant insulin, human growth hormone

Unit 3: Genetically Modified Organisms / Transgenics & Applications (12 hours)

- 3.1 GMO/Transgenic animals
- 3.2 Production of GMO/transgenic animals: Gene Transfer Methods
 - 3.2.1 Electroporation
 - 3.2.2 Microprojectile/particle Bombardment (biolistics)
 - 3.2.3 DNA Microinjection
 - 3.2.4 Nuclear Transplantation (Dolly sheep)
 - 3.2.5 Retroviral Method
- 3.3 Applications of transgenic animals:
 - 3.3.1 Xenotransplantation
 - 3.3.2 Transpharmers
 - 3.3.3 Disease Resistant Animals
 - 3.3.4 Transgenic Animals in Agriculture and Aquaculture (Product improvement)

Unit 4: Animal biotechnology in Livestock, Aquaculture (11 hours)

- 4.1 Livestock improvement: Manipulation of reproduction in animals:
 - 4.1.1 Artificial insemination
 - 4.1.2 *in-vitro* fertilization
 - 4.1.3 Embryo transfer technology
- 4.2 Improvement of Aquaculture:
 - 4.2.1 Aquaculture and fish seed production: induced breeding
- 4.3 Legal and ethical issues in animal biotechnology

Practicum: (30 hours)

1. Demonstration of Genomic DNA extraction from *E.coli*
2. Demonstration of Plasmid DNA isolation (pUC 18/19) from *E.coli*
3. To study the various Cloning vectors –their properties and functions through diagrams.
4. Demonstration of Restriction digestion of Plasmid / lambda (λ) DNA using EcoR1
5. Study of important equipment used in Animal Cell Culture.
6. Study of the sterilization methods for glass and plastic wares for cell culture.
7. To study the working principle of laminar air flow
8. Preparation and sterilization of culture media.
9. Culture and maintenance of bacterial (*E.coli*)
10. To study transgenic animals through photographs.

NOTE FOR CONDUCTING PRACTICALS (MANDATORY)

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External End Semester Theory Examination will have two sections (A & B) (Total Marks 60)

Section A: Four short answer questions representing all units/syllabi i.e., one question from each unit. Each question shall be of 3 marks.

Section B: Eight long answer questions (Four to be attempted) representing whole of the syllabi i.e., two questions from each unit. Each question shall be of 12 marks.

Internal Assessment (Total Marks 15)

Fifteen (15) marks for theory paper in a subject reserved for internal assessment shall have one long answer type question of 7 marks and four short answer type questions of 2 marks each.

Recommended Readings:

1. Singh, B. SK Gautam, M S Chauhan, and S K Singla (2015). Textbook of Animal Biotechnology New Delhi: TERI
2. Srivastava, A.K. and Singh, R.K. (2018). Animal Biotechnology. CBS Publishers & Distributors
3. Gupta, P. K. (2021). Animal Biotechnology. Rastogi Publications, India
4. Mathur, J.P. and Barnes, D. (1998). Methods in Cell Biology. Animal Cell Culture Methods. Academic Press
5. Brown, T.A. (1998). Molecular Biology Labfax II: Gene Cloning and DNA Analysis. II Edition, Academic Press, California, USA.
6. Glick, B.R. and Pasternak, J.J. (2009). Molecular Biotechnology- Principles and Applications of Recombinant DNA. IV Edition, ASM press, Washington, USA.
7. Griffiths, A.J.F., J.H. Miller, Suzuki, D.T., Lewontin, R.C. and Gelbart, W.M. (2009). An Introduction to Genetic Analysis. IX Edition. Freeman and Co., N.Y., USA.
8. Watson, J.D., Myers, R.M., Caudy, A. and Witkowski, J.K. (2007). Recombinant DNA Genes and Genomes-A Short Course. III Edition, Freeman and Co., N.Y., USA.
9. Snustad, D.P. and Simmons, M.J. (2009). Principles of Genetics. V Edition, John Wiley and Sons Inc.
10. Beauchamp, T.I. and Childress, J.F. (2008). Principles of Biomedical Ethics. VI Edition, Oxford University Press.



UNIVERSITY OF JAMMU
SYLLABI AND COURSE OF STUDY IN ZOOLOGY UNDER CBCS AS
PER NEP - 2020
(For the Examination to be held in Year 2024, 2025 & 2026)
(MAJOR COURSE)
UG SEMESTER-V

MAJOR CORE COURSE NO.	:	UMJZOT504
MAJOR CORE COURSE TITLE	:	HUMAN GENETICS
CREDITS	:	02 (THEORY)
MAXIMUM MARKS THEORY	:	50
I) External (University Exam)	:	40
II) Internal Assessment	:	10
DURATION OF UNIVERSITY EXAM	:	02 Hours30Minutes

Objectives and Expected Learning Outcomes

The course aims to provide students with a comprehensive understanding of human genetics and chromosomes. The objectives include tracing the historical evolution of human genetics, comprehending challenges in genetic studies, grasping chromosome classification and banding techniques, interpreting human karyotypes, and analyzing structural modifications' impacts on phenotypes. Students will also explore various genetic disorders, inheritance patterns, and metabolic errors. Practical aspects encompass constructing pedigrees, identifying karyotypic abnormalities, studying Barr bodies, conducting genetic tests, and recognizing chromosomal disorders. By the end of the course, students will possess the skills to analyze genetic data, diagnose disorders, and offer genetic counseling, fostering a holistic grasp of human genetics and its applications.

Unit 1: Introduction to Human Genetics and Human Chromosomes (10 hours)

- 1.1 Human chromosomes: Classification and nomenclature
 - 1.1.1 History of classification, nomenclature and characteristics of A to G groups of Human chromosomes.
 - 1.1.2 Concept of banding techniques – Trypsin G-banding
 - 1.1.3 Human karyotyping and its application
- 1.2. Chromosome structural modification and the human phenotype
 - 1.2.1 Philadelphia chromosome
 - 1.2.2 Cri-du-chat syndrome (5p-syndrome)
 - 1.2.3 Pader-Willi Syndrome
 - 1.2.4 Burkitt's lymphoma (14q+ syndrome)

Unit 2: Human Disorders and inborn errors of metabolism (10 hours)

- 2.1. Autosomal disorders
 - 2.1.1 Huntington's disease
 - 2.1.2 Thalassemia
- 2.2. X-linked disorders
 - 2.2.1 Hemophilia
 - 2.2.2 Colour blindness
- 2.3. Non-disjunction of Chromosomes and Human Disorders



- 2.3.1 Non-disjunction of autosomes (Down's Syndrome, Edwards Syndrome, Patau's Syndrome)
- 2.3.2 Non-disjunction of sex chromosomes (Turner's Syndrome, Klinefelter's Syndrome, XXX Syndrome, XYY Syndrome)
- 2.3.3 Mosaicism
- 2.4 Inborn errors of metabolism
 - 2.4.1 Phenylketonuria
 - 2.4.2 Albinism
 - 2.4.3 G6PD Deficiency

Unit 3: Diagnosis, prevention & treatment of Human Genetic Disorders (10 hours)

- 3.1 Prenatal Diagnosis
 - 3.1.1 Concept of Prenatal diagnosis and its importance
 - 3.1.2 Invasive techniques: CVS & Amniocentesis
 - 3.1.3 Non-invasive techniques: Ultrasonography, Biochemical markers
- 3.2 Pedigree Analysis, its importance and Symbols used in Pedigree
- 3.3 Genetic Counselling and its purpose
- 3.4 Basic Concepts of Eugenics and Euphenics
- 3.5 Gene Therapy for human genetic disorders

NOTE FOR PAPER SETTERS:

Total Marks of this course is 50 of which 20% marks shall be reserved for internal assessment (10 marks). Remaining 80% of the marks (40 marks) shall be reserved for external examination to be conducted by the University/Colleges.

Internal Assessment Test (10 Marks)

Internal Assessment Paper of 10 Marks shall consist of two sections:

- Section A: Five (5) short answer type questions of 1 marks each (all compulsory)
- Section B: One (1) long answer question of 5 marks with internal choice.

External End Semester University/College Examination

External Theory Exam shall be of 40 Marks and consist of 2 sections:

Section A: Four (4) short answer questions representing all Units/Syllabi i.e., at least one question from each unit. Each question shall be of 2.5 marks (All Compulsory)

Section B: Six (6) long answer questions (Three to be attempted) representing whole of the syllabi i.e., two questions from each unit. Each question shall be of 10 marks.

RECOMMENDED READINGS

1. S D Gangane. Human Genetics, Elsevier Fifth Edition.
2. Alice Marcus. Human Genetics, An Overview.
3. W K Balwan. DBS Handbook of Genetics, DBS Imprints, Delhi.
4. Ricki Lewis. Human Genetics: Concepts and Applications. McGraw Hill, 12th Edition.
5. Bheem Prasad. Human Genetics for Medical & life Sciences. Current Book Internationals.
6. W K Balwan. Genetics. Virgo Publishers



FYUGP (SEMESTER-V)

TITLE-HUMAN GENETICS
COURSE CODE- UMJZOT504

2024-26

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7. G P Pal. Medical Genetics. AITBS Publishers, India
 8. Jayesh Sheth and Frenny Sheth. Genetics in Clinical Practice.
 9. Yogesh Ashok Sontakke. Principles in Clinical Genetics. Jaypee Publishers.
 10. P Turnpenny, Sian Ellard & Ruth Cleaver. Emery's Elements of Medical Genetics & Genomics.



UNIVERSITY OF JAMMU
SYLLABI AND COURSE OF STUDY IN ZOOLOGY UNDER CBCS AS
PER NEP - 2020
(For the Examination to be held in Year 2024, 2025 & 2026)
(MINOR COURSE)
UG SEMESTER-V

MINOR CORE COURSE NO.	:	UMIZOT505
MINOR CORE COURSE TITLE	:	NON-CHORDATE DIVERSITY
CREDITS	:	04 {03 (THEORY) + 01 (Practical)}
MAXIMUM MARKS	:	75
I) External (University Exam)	:	60
II) Internal Assessment	:	15
DURATION OF UNIVERSITY EXAM	:	03Hours
MAXIMUM MARKS PRACTICALS	:	25
I) Continuous Assessment	:	10
II) Final Examination	:	15

Objectives and Expected Learning Outcomes

The course aims to provide undergraduate students with a comprehensive understanding of the diverse world of non-chordate animals, encompassing their structural organization, classification, functional adaptations, and evolutionary significance. Through a systematic exploration of key phyla such as Protozoa, Porifera, Coelenterata, Platyhelminthes, Aschelminthes, Annelida, Arthropoda, Mollusca, and Echinodermata, students will develop a strong foundation in non-chordate zoology, fostering the ability to recognize and appreciate the intricate mechanisms that have shaped these organisms and their ecosystems.

Unit 1: Introduction to Non-Chordate Zoology and Protozoa (10 hours)

- 1.1 Structural Organization and Classification
 - 1.1.1 Basis of classification in non-chordates
 - 1.1.2 Types of symmetry
- 1.2 Protozoa
 - 1.2.1 General characters and classification up to class level with examples
 - 1.2.2 Locomotion in Protozoa
 - 1.2.3 Nutrition in Protozoa
 - 1.2.4 Osmoregulation in Protozoa
 - 1.2.5 Habit-Habitat, External Morphology, Reproduction and Life History of *Paramecium*

Unit 2: Porifera and Coelenterata (10 hours)

- 2.1 Porifera
 - 2.1.1 General characters and classification up to class level with examples
 - 2.1.2 Histological elements and Skeleton system in Porifera



2.1.3 Canal system in Porifera

2.1.4 Habit-Habitat, External Morphology, Reproduction and Life History of *Scypha (Sycon)*

2.2 Coelenterata

2.2.1 General characters and classification up to class level with examples

2.2.2 Habit-Habitat, External Morphology, Reproduction and Life History of *Metridium*

2.2.3 Polymorphism in Coelenterates

2.2.4 Coral reefs and types

Unit 3: Platyhelminthes, Aschelminthes, and Annelida**(12 hours)**

3.1 Platyhelminthes

3.1.1 General characters and classification up to class level with examples

3.1.2 Habit-Habitat, External Morphology, Reproduction and Life History of the following platyhelminthes

3.1.2.1 *Taenia solium*3.1.2.2 *Fasciola hepatica*

3.2 Aschelminthes

3.2.1 General characters and classification up to class level with examples

3.2.2 Habit-Habitat, External Morphology, Reproduction and Life History of *Ascaris lumbricoides*

3.3 Annelida

3.3.1 General characters and classification up to class level with examples

3.3.2 Habit-Habitat, External Morphology and Reproduction of the Earthworm

Unit 4: Arthropoda, Mollusca, and Echinodermata**(13 hours)**

4.1 Arthropoda

4.1.1 General characters and classification up to class level

4.1.2 Metamorphosis and its types in Insects

4.1.3 Habit-Habitat, External Morphology, Nervous system and Reproduction of the Prawn

4.2 Mollusca

4.2.1 General characters and classification up to class level with examples

4.2.2 Habit-Habitat, External Morphology and Nervous system of *Pila globosa*

4.2.3 Torsion in Molluscs

4.3 Echinodermata

4.3.1 General characters and classification up to class level with examples

4.3.2 Echinoderm larvae and their significance

4.3.3 Water vascular system in *Asterias* (Starfish)**Practicum****(30 Hours)**

- Museum Specimens:** *Sycon*, *Euspongia*, *Euplectella*, *Hyalonema*, *Hydra*, *Obelia*, *Millepora*, *Tubularia*, *Sertularia*, *Physalia*, *Verella*, *Porpita*, *Aurelia*, Sea anemone, Corals, *Planaria*, *Fasciola*, *Schistosoma*, *Taenia*, *Ascaris*, *Ancylostoma*, *Nereis*, *Heteroneis*, *Aphrodite*, *Tubicola*, *Chaetopterus*, *Terebella*, *Serpula*, *Arenicola*, *Lumbricus*, *Pheretima*, *Hirudinaria*, *Pontobdella*, *Hirudo*, *Balanus*, *Lepas*, Crayfish, Prawn, hermit-crab, honey bee, cockroach, grasshopper; house fly, praying mantis, stick insect, dragon fly, *Lepisma*, termites, scorpion, spider,

FYUGP (SEMESTER-V)
TITLE-NON-CHORDATE DIVERSITY 2024-26
COURSE CODE- UMIZOT505

Limulus, Millipede, Centipede, *Pila*, *Chiton*, *Mytilus*, *Unio*, *Pecten*, pearl oyster, *Dentalium*, *Patella*, *Murex*, *Helix*, *Lymnaea*, *Planorbis*, *Loligo*, *Sepia*, *Octopus*, *Nautilus*, *Antedon*, *Asterias*, *Holothuria*, *Echinus*, *Ophiothrix*.

2. **Microscopic slides (Whole Mount):** *Euglena*, *Trypanosoma*, *Amoeba*, *Entamoeba*, *Leishmania*, *Giardia*, *Monocystis*, *Plasmodium*, *Paramecium*, *Vorticella*, L.S. and T.S. of *Sycon*, sponging spicules, sponging fibres and gemmules, *Hydra*
3. **Preparation of permanent stained mounts:** *Obelia*, Parapodium of *Nereis*, Nephridium of earth worm, Ovary of earthworm, Statocyst of prawn, Mouthparts and trachea of cockroach, mouth parts of mosquito.
4. A visit to Zoological Museum, Butterfly Park, Department of Zoology, University of Jammu.

NOTE FOR CONDUCTING PRACTICALS (MANDATORY)

Practicals to be conducted mandatorily in separate groups as per UGC guidelines (15-20 students per group) in addition to theory classes.

NOTE FOR PAPER SETTING

Examination Theory/Practical	Syllabus to be Covered in Examination	Time allotted for Exam	Marks
Internal Theory Assessment	50%	1Hr & 30 Minutes	15
External Theory End Semester	100%	3Hrs	60
Continuous assessment	-	-	10 (Based on Daily Performance only)
Final Examination	-	-	15

External End Semester Theory Examination will have two sections (A&B) {Total marks 60}

Section A : Four short answer questions representing all units/syllabi i.e., one question from each unit. Each question shall be of 3 marks.

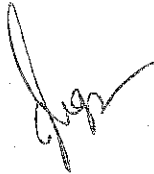
Section B: Eight long answer questions (Four to be attempted) representing whole of the syllabi i.e., two questions from each unit. Each question shall be of 12 marks.

Internal Assessment {Total marks 15}

Fifteen (15) marks for theory paper in a subject reserved for internal assessment shall have one long answer type question of 7 marks and four short answer type questions of 2 marks each.

Recommended Readings:

1. Ruppert and Barnes, R.D. (2006). Invertebrate Zoology, VIII Edition. Holt Saunders, International Edition.
2. Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. and Spicer, J.I. (2002). The Invertebrates: A New Synthesis, III Edition, Blackwell Science
3. Barrington, E.J.W. (1979). Invertebrate Structure and Functions. II Edition, E.L.B.S. and Nelson
4. Young, J. Z. (2004). The Life of Vertebrates. III Edition. Oxford university press.
5. Pough H. Vertebrate life, VIII Edition, Pearson International.
6. Darlington P.J. The Geographical Distribution of Animals, R.E. Krieger Pub Co.
7. Hall B.K. and Hallgrimsson B. (2008). Strickberger's Evolution. IV Edition. Jones and Bartlett Publishers Inc.
8. Arora, Mohan P. (2006), Non-chordata – I, Himalaya Publishing House, Mumbai
9. Kotpal, R. L. (2020), Modern Text Book of Zoology: Invertebrates (12th Ed.), Rastogi Publications
10. Verma, P. S., (2001) Invertebrate Zoology (Multicolour Edition) S. Chand & Co. Publishing



UNIVERSITY OF JAMMU
SYLLABI AND COURSE OF STUDY IN ZOOLOGY UNDER CBCS AS
PER NEP - 2020
(For the Examination to be held in Year 2024, 2025 & 2026)
(INTERNSHIP COURSE)
UG SEMESTER-V

Course Code: USEZOI506
Credits: 02

Course Title: Summer Internship
Max. Marks: 50

Objectives:

It shall be a short-term internship of 15 days duration in 5th semester for job/professional training in a suitable organization or hands on training or activity-based course at college level in order to gain work experience.

All students will undergo internships / Apprenticeships in a firm, industry, or organization or Training in labs with faculty and researchers in their own or other HEIs/research institutions during the summer term. Students will be provided with opportunities for internships with local industry, business organizations, health and allied areas, local governments (such as panchayats, municipalities), Parliament or elected representatives, media organizations, artists, crafts persons, and a wide variety of organizations so that students may actively engage with the practical side of their learning and, as a by-product, further improve their employability.

Community engagement and service: The curricular component of 'community engagement and service' seeks to expose students to the socio-economic issues in society so that the theoretical learning can be supplemented by actual life experiences to generate solutions to real-life problems. This can be part of summer term activity.

Field-based learning/minor project: The field-based learning/minor project will attempt to provide opportunities for students to understand the different socio-economic contexts. It will aim at giving students exposure to development-related issues in rural and urban settings. It will provide opportunities for students to observe situations in rural and urban contexts, and to observe and study actual field situations regarding issues related to socioeconomic development. Students will be given opportunities to gain a first-hand understanding of the policies, regulations, organizational structures, processes, and programmes that guide the development process. They would have the opportunity to gain an understanding of the complex socio-economic problems in the community, and innovative practices required to generate solutions to the identified problems. This may be a summer term project.

SCHEME OF EXAMINATION

The internship shall be under a college teacher who will be designated as Internship Supervisor. After completion of summer internship students will have to produce a report related to the work carried out signed by internship supervisor and college principal. The internship will be evaluated internally by a Board of Examiners set up by the principal of the college.

Note: The minimum passing criteria for the summer internship is 40%.



Scheme of Internship

It shall be a short-term internship of duration 15 days for a job/professional training in a suitable organization or hands on training or activity-based course at college level in order to gain work experience. The internship shall be under a college teacher who will be designated as Internship Supervisor. After completion of summer internship students will have to produce a report related to the work carried out.

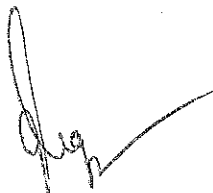
Report Guidelines: The interns will write their report as per the format given below:

1. Introduction
2. Materials and Methods
3. Results
4. Discussion
5. Conclusion
6. References

This structure allows participants to gain hands-on experience in various laboratory techniques and apply their knowledge through a project. The project report serves as a valuable component to assess their understanding and application of the learned skills.

Monitoring and Evaluation:

The designated Internship Supervisor will monitor the progress and evaluate student's internship course at the end of semester on the basis of Internship Report/Seminar presentation/Viva-voce.



University of Jammu

Syllabi of Zoology for FYUGP under CBCS as per NEP-2020,

SEMESTER-VI

(Examination to be held in 2025, 2026, 2027)

Course Code: UMJZOT601

Major Course

Course Title: Life and Diversity of Chordates

Credits: 04 {03(Theory) + 01(Practical)}

Total no. of lectures: Theory: 45 hours
Practical: 30 hours

Maximum Marks: 100

Theory: 75

Practical/Tutorial: 25

Course Code: UMJZOT602

Major Course

Course Title: Economic Zoology

Credits: 04 {03(Theory) + 01(Practical)}

Total no. of lectures: Theory: 45 hours
Practical: 30hours

Maximum Marks: 100

Theory: 75

Practical/Tutorial: 25

Course Code: UMJZOT603

Major Course

Course Title: Animal Behaviour and Chronobiology

Credits: 04 {03(Theory) + 01(Practical)}

Total no. of lectures: Theory: 45 hours
Practical: 30hours

Maximum Marks: 100

Theory: 75

Practical/Tutorial: 25

Course Code: UMJZOT604

Major Course

Course Title: Biochemistry of Metabolic Processes

Credits: 04 {03(Theory) + 01(Practical)}

Total no. of lectures: Theory: 45 hours
Practical: 30hours

Maximum Marks: 100

Theory: 75

Practical/Tutorial: 25

Course Code: UMIZOT605

Minor Course

Course Title: Chordate Diversity

Credits: 04{03(Theory) + 01(Practical)}

Total no. of lectures: Theory: 45 hours
Practical: 30hours

Maximum Marks: 100

Theory: 75

Practical/Tutorial: 25



UNIVERSITY OF JAMMU
SYLLABI AND COURSE OF STUDY IN ZOOLOGY
UNDER CBCS AS PER NEP - 2020
(For the Examination to be held in Year 2025, 2026 & 2027)
(MAJOR COURSE)

UG SEMESTER-VI

MAJOR CORE COURSE NO.	:	UMJZOT601
MAJOR CORE COURSE TITLE	:	LIFE AND DIVERSITY OF CHORDATES
CREDITS	:	04 {03 (THEORY) + 01 (Practical)}
MAXIMUM MARKS	:	75
I) External (University Exam)	:	60
II) Internal Assessment	:	15
DURATION OF UNIVERSITY EXAM	:	03 Hours
MAXIMUM MARKS PRACTICALS	:	25
I) Continuous Assessment	:	10
II) Final Examination	:	15

Objectives and Expected Learning Outcomes

The course aims to provide students with a comprehensive understanding of chordates and their diversity, encompassing the classification and distinguishing characteristics of chordates, protochordates, advanced vertebrates, and tetrapods, including amphibians, reptiles, birds, and mammals. Students will explore the evolutionary history, habitat, and morphology of these diverse groups, allowing them to appreciate the significant concepts related to chordate origins, aquatic adaptations, and adaptive radiations in mammals and birds. By the end of the course, students will have a solid foundation in the life and diversity of chordates, enabling them to recognize, classify, and comprehend the ecological and evolutionary aspects of these organisms.

Unit 1: Chordata: Protochordates (Acrania)

(10 hours)

1.1 General Characters and outline classification of Chordata up to class level

1.2 Protochordata

1.2.1 General characteristics, classification and affinities of Hemichordata, Urochordata and Cephalochordata

1.2.2 Habit-habitat and External morphology of

1.2.2.1 *Balanoglossus*

1.2.2.2 *Herdmania*.

1.2.2.3 *Branchiostoma* (Amphioxus)

1.2.3 Study of larval forms in protochordates

23

- 1.2.4 Retrogressive metamorphosis in Urochordata
1.3 Origin of Chordata: Dipleurula concept and the Echinoderm theory of origin of chordates

Unit 2: Introduction to Vertebrates (Craniata): Agnatha and Pisces (12 hours)

- 2.1 Advanced features of vertebrates over Protochordata
2.2 Agnatha
2.2.1. General characters and classification of cyclostomes up to order level
2.2.2. Structural peculiarities and affinities of *Petromyzon* and *Myxine*.
2.3 Pisces
2.3.1 General characteristics of Chondrichthyes and Osteichthyes, classification upto order level
2.3.2 Habit-habitat and External morphology of *Scoliodon*
2.3.3 Habit-habitat, External morphology and Evolutionary significance of *Latimeria*
2.3.4. Scales in Fishes
2.3.5 Lateral line system in Fishes
2.3.6 Swim Bladder: Type, Structure and Functions
2.3.7 Osmoregulation in Fishes

Unit 3: Tetrapoda: Amphibians and Reptiles (10 hours)

- 3.1 Origin of Tetrapoda (Evolution of terrestrial ectotherms)
3.2 Amphibia
3.2.1 General characters and classification up to order level
3.2.2 Habit-habitat, External morphology of *Rana tigrina*
3.2.3 Neoteny and Paedogenesis in Amphibia
3.3 Reptilia
3.3.1 General characters and classification up to order level
3.3.2 Habit-habitat, External morphology of *Hemidactylus flaviviridis*
3.3.3 *Sphenodon*: Morphology and evolutionary significance
3.3.4 Poison apparatus and Biting mechanism in snakes
3.3.5 Identification of poisonous and non-poisonous snakes

Unit 4: Tetrapoda: Birds and Mammals (13 hours)

- 4.1 Aves
4.1.1 General characters and classification up to order level
4.1.2 Habit-habitat, External morphology of *Columba livia*
4.1.3 *Archaeopteryx*- a missing link
4.1.4 Feather and their types in Birds
4.1.5 Flight adaptations in Birds
4.2 Mammals

- 4.2.1 General characters and classification up to order level
- 4.2.2 Habit-habitat, External morphology of *Oryctolagus*
- 4.2.3 Aquatic adaptations in Mammals
- 4.2.4 Adaptive radiation in Mammals with reference to locomotory appendages

Practicum

(30hours)

1. Study of diverse type of chordates through museum specimens/charts/photographs

- a) **Protochordata:** *Balanoglossus, Herdmania, Branchiostoma, Salpa*
 - b) **Agnatha:** *Petromyzon, Myxine, Ammocoetus larva*
 - c) **Fishes:** *Scoliodon, Sphyrna, Stegostoma, Pristis, Torpedo, Trygon, Chimaera, Protopterus, Salmo, Clarias, Mystus, Heteropneustes, Ophiocephalus, Labeo, Exocoetus, Echeneis, Anguilla, Hippocampus, Tetrodon/Diodon, Anabas, Pterois*
 - d) **Amphibia:** *Ichthyophis/Ureotyphlus, Ambystoma, Axolotl larva, Necturus, Salamandra, Rana, Bufo, Hyla, Alytes*
 - e) **Reptilia:** *Chelone, Trionyx, Kachuga, Testudo, Sphenodon, Hemidactylus, Varanus, Uromastix, Chamaeleon, Ophiosaurus, Draco, Typhlops, Python, Boa, Bungarus, Vipera russeli, Naja, Hydrophis, Bungarus, Ptyas mucosa, Crocodylus, Gavialis*
 - f) **Aves:** *Penguin, Struthio, Eudynamys, Psittacula, Coracias benghalensis, Passer domesticus, Corvus splendens, Anser indicus, Pavo cristatus*
 - g) **Mammalia:** *Echidna, Macropus, Talpa, Pteropus giganteus, Desmodus, Armadillo, Manis, Loris, Funambulus, Herpestes, Erinaceous, Balaenoptera musculus, Platanista gangetica, Dugong, Hyaena hyaena, Panthera leo, Panthera pardus, Panthera tigris, Panthera uncia, Acinonyx jubatus, Elephas maximus, Equus, Rhinoceros unicornis, Hippocampus, Sus scrofa, Axis axis*
- 2. Study of temporary/permanent mounts of the following:**
- a) Sections of *Amphioxus* through pharyngeal, intestinal and caudal regions.
 - b) Weberian ossicles
 - c) Ampullae of Lorenzini
 - d) Placoid, Ctenoid, Cycloid scales of fish
- 3. Key for Identification of poisonous and non-poisonous snakes**
- 4. Types of beaks, claws and feathers in birds**

NOTE FOR CONDUCTING PRACTICALS (MANDATORY)

Practicals to be conducted mandatorily in separate groups as per UGC guidelines (15-20 students per group) in addition to theory classes.

NOTE FOR PAPER SETTING

Examination Theory/Practical	Syllabus to be Covered in Examination	Time allotted for Exam	Marks
Internal Theory Assessment	50%	1Hr & 30 Minutes	15
External	100%	3Hrs	60

UNIVERSITY OF JAMMU
SYLLABI AND COURSE OF STUDY IN ZOOLOGY
UNDER CBCS AS PER NEP - 2020
(For the Examination to be held in Year 2025, 2026 & 2027)
(MAJOR COURSE)

UG SEMESTER-VI

MAJOR CORE COURSE NO.	:	UMJZOT602
MAJOR CORE COURSE TITLE	:	ECONOMIC ZOOLOGY
CREDITS	:	04 {03 (THEORY) + 01 (Practical)}
MAXIMUM MARKS	:	75
I) External (University Exam)	:	60
II) Internal Assessment	:	15
DURATION OF UNIVERSITY EXAM:	:	03 Hours
MAXIMUM MARKS PRACTICALS:	:	25
I) Continuous Assessment	:	10
II) Final Examination	:	15

Objectives and Expected Learning Outcomes

The course outcomes in Economic Zoology are designed to provide students with a well-rounded understanding of economically significant aspects of the animal kingdom, spanning honey bee cultivation, sericulture, aquaculture, livestock management, and pest control. By the end of the course, students will have gained the ability to appreciate the intricate processes involved in the production of honey, silk, and lac, while also comprehending the key principles and practices of poultry farming, dairy management, and fish culture. Furthermore, students will be equipped with the knowledge and skills to identify, diagnose, and manage a variety of animal pests, with a strong emphasis on the principles of integrated pest management and environmentally responsible practices. The course not only fosters critical thinking and problem-solving skills but also encourages students to apply their knowledge in practical settings, preparing them for diverse career opportunities in agriculture, animal husbandry, and pest control.

Unit 1: Economically beneficial insects

(14 hours)

1.1 Apiculture:

- 1.1.1 Different species of honey bees and their distribution
- 1.1.2 Social organization and life cycle of honey bee
- 1.1.3 Methods of bee keeping
 - 1.1.3.1 Indigenous methods and their drawbacks
 - 1.1.3.2 Modern methods of Apiculture: Modern Bee Hive (Langstroth hive) and Beekeeping Equipment
- 1.1.3 Economically important bee products: Formation, composition and uses of Honey, Bee wax, Royal jelly, Propolis, Bee venom




UNIVERSITY OF JAMMU
SYLLABI AND COURSE OF STUDY IN ZOOLOGY
UNDER CBCS AS PER NEP - 2020
(For the Examination to be held in Year 2025, 2026 & 2027)
(MAJOR COURSE)

UG SEMESTER-VI

MAJOR CORE COURSE NO.	:	UMJZOT602
MAJOR CORE COURSE TITLE	:	ECONOMIC ZOOLOGY
CREDITS	:	04 {03 (THEORY) + 01 (Practical)}
MAXIMUM MARKS	:	75
I) External (University Exam)	:	60
II) Internal Assessment	:	15
DURATION OF UNIVERSITY EXAM:	:	03 Hours
MAXIMUM MARKS PRACTICALS:	:	25
I) Continuous Assessment	:	10
II) Final Examination	:	15

Objectives and Expected Learning Outcomes


The course outcomes in Economic Zoology are designed to provide students with a well-rounded understanding of economically significant aspects of the animal kingdom, spanning honey bee cultivation, sericulture, aquaculture, livestock management, and pest control. By the end of the course, students will have gained the ability to appreciate the intricate processes involved in the production of honey, silk, and lac, while also comprehending the key principles and practices of poultry farming, dairy management, and fish culture. Furthermore, students will be equipped with the knowledge and skills to identify, diagnose, and manage a variety of animal pests, with a strong emphasis on the principles of integrated pest management and environmentally responsible practices. The course not only fosters critical thinking and problem-solving skills but also encourages students to apply their knowledge in practical settings, preparing them for diverse career opportunities in agriculture, animal husbandry, and pest control.

Unit 1: Economically beneficial insects

(14 hours)

1.1 Apiculture:

- 1.1.1 Different species of honey bees and their distribution
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 - 1.1.3.2 Modern methods of Apiculture: Modern Bee Hive (Langstroth hive) and Beekeeping Equipment
- 1.1.3 Economically important bee products: Formation, composition and uses of Honey, Bee wax, Royal jelly, Propolis, Bee venom




- 1.1.4 Common Diseases of Honey bees-Acarine and Nosema: Causes, symptoms and prevention
- 1.1.5 Role of honey bees in pollination.
- 1.2 Sericulture
 - 1.2.1 Silk producing insects in India (distribution, host plants, rearing) and kinds of silk produced.
 - 1.2.2 Life cycle of Silk moth
 - 1.2.3 Modern method and principles of silkworm rearing and silk production.
 - 1.2.4 Common diseases of silkworm /silk moth: Pebrine Disease
 - 1.2.5 Economic importance of silk and other products/by-products of sericulture industry.
- 1.3 Lac Culture
 - 1.3.1 Life cycle of Lac insect
 - 1.3.2 Method of Lac cultivation, lac extraction/processing and uses

Unit 2: Live Stock Management**(11 hours)**

- 2.1 Poultry farming.
 - 2.1.1 Breeds of Poultry birds and their characteristics: Indigenous breeds (Aseel, Chittagong, Minorca), Exotic breeds (White Leghorn, Rhode island red)
 - 2.1.2 Poultry breeding and rearing practices
 - 2.1.3 Poultry feeds and feeding
 - 2.1.4 Poultry diseases: causes, symptoms and prevention (Ranikhet, Coccidiosis)
- 2.2 Dairy Farming
 - 2.2.1 Breeds of Dairy Cattle and their characteristics: Indigenous breeds (Sahiwal, Red Sindhi, Hariana), Exotic Breeds (Red Dane, Jersey, Holstein-Fresian)
 - 2.2.2 Cattle Feeds: Roughages and Concentrates
 - 2.2.3 Milk and milk products: Production, Composition and Preservation
 - 2.2.4 Cattle diseases: causes, symptoms, prevention and treatment (Mastitis, Foot and Mouth disease)

Unit 3: Aquaculture**(10 hours)**

- 3.1 Definition, Status and Scope of Aquaculture
- 3.2 Fish Culture Practices:
 - 3.2.1 Carp Culture
 - 3.2.2 Polyculture/Composite Fish Culture
 - 3.2.3 Induced Breeding in Fish
 - 3.2.4 Economic importance of fish
- 3.3 Prawn Culture: Culture of Freshwater prawn (*Macrobrachium rosenbergii*)
- 3.4 Pearl Culture and its economic importance



Unit 4: Animal Pests and Control**(10 hours)**

- 4.1 Economically important Phytoparasitic Nematodes and their control:
Meloidogyne, Heterodera
- 4.2 Insect Pests: diagnostic features, damage caused and control measures
- 4.2.1 Pests of stored crops: *Sitophilus oryzae*, *Tribolium castaneum*,
- 4.2.2 Pests of standing crops: *Leptocorisa varicornis*, *Pectinophora gossypiella*
- 4.2.3 Termites: Types, castes, damage, prevention control.
- 4.3 Biocontrol Agents
- 4.3.1 Concept and Relevance
- 4.3.2 Criteria for organisms to act as biocontrol agents
- 4.3.3 Biocontrol of the pests through following agents:
- 4.3.3.1 *Bacillus thuringiensis*
- 4.3.3.2 Insecticidal Nematode species

Practicum**(30 hours)**

1. Study the morphological features of honey bee
2. Study of mouth parts, sting apparatus and hind legs of honey bee from slides
3. Study of the life history of honey bee
4. Study of life history of *Bombyx mori*
5. Study of type of silk fibers from prepared slides.
6. Candling of egg of fowl for differentiation of the fertilized eggs from the unfertilized eggs
7. Study of insect pest: Rice- weevil, Red flour beetle, Lesser Grain borer, Rice- Gundi bug, Pink boll worm of cotton, Bihar hairy caterpillar
8. Collection and preservation of insect pests
9. Identification of locally available major and minor carps.
10. Identification of cultivable Prawn, crab, lobster
11. A visit of apiary, poultry farm, dairy farm, and fish farm/aquarium
12. Study of *Trichonympha* from the gut of termites

NOTE FOR CONDUCTING PRACTICALS (MANDATORY)

Practicals to be conducted mandatorily in separate groups as per UGC guidelines (15-20 students per group) in addition to theory classes.

NOTE FOR PAPER SETTING

Examination Theory/Practical	Syllabus to be Covered in Examination	Time allotted for Exam	Marks
Internal Theory Assessment	50%	1Hr & 30 Minutes	15
External Theory End Semester	100%	3Hrs	60
Continuous assessment	-	-	10 (Based on Daily Performance)

			only)
Final Examination	-	-	15

External End Semester Theory Examination will have two sections (A&B) {Total marks 60}

Section A: Four short answer questions representing all units/syllabi i.e., one question from each unit. Each question shall be of 3 marks.

Section B: Eight long answer questions (Four to be attempted) representing whole of the syllabi i.e., two questions from each unit. Each question shall be of 12 marks.

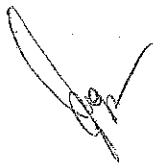
Internal Assessment {Total marks 15}

Fifteen (15) marks for theory paper in a subject reserved for internal assessment shall have one long answer type question of 7 marks and four short answer type questions of 2 marks each.

Recommended Readings:

1. Banerjee, T. K. (2016), Applied Zoology. New Central Book Agency (P) Ltd., Kolkata
2. Cherian & Ramachandran. Bee keeping in South Indian Govt. Press, Madras.
3. David, B.V. and Ananthakrishnan, T.N. (2004) General and Applied Entomology. Tata McGraw-Hill Publishing Com- pany Limited, New Delhi.
4. Eikichi, H. (1999). Silkworm Breeding (Translated from Japanese). Oxford & IBH Publishing Co.Pvt. Ltd., New Delhi
5. Ganga, G. (2003). Comprehensive Sericulture Vol-II: Silkworm Rearing and Silk Reeling. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
6. JabdePradip V (2005) Textbook of Applied Zoology: Vermiculture, Apiculture, Sericulture, Lac Culture, Agricultural Pests and their Controls. Discovery Publishing Pvt. Ltd
7. K. Rataj, R. Zukal, D. Coxon (1971). Aquarium Fishes and Plants. Littlehampton Book Services Ltd
8. K.N. Ragumoorthi, V. Balasubramani, N. Natarajan, M.R. Srinivasan (2016) Principles Of Applied Entomology. Ae Publications
9. Larry P. Pedigo, Marlin E. Rice (2006) Entomology and Pest Management; Edition 5, Pearson Prentice Hall
10. Mahadevappa, D., Halliyal, V.G., Shankar, D.G. and Bhandiwad, R., (2000). Mulberry Silk Reeling Technology. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
11. R. Santhanam, N. Sukumaran, P. Natarajan. (1990). A Manual of Fresh Water Aquaculture. South Asia Books
12. Roger, M (1990). The ABC and Xyz of Bee Culture: An Encyclopaedia of Beekeeping, A I Root Co.
13. Sammataro, D., Avitabile, A., Caron, D.M. (2021). The Beekeeper's Handbook, Cornell University Press.
14. Sarkar, Kundu and Shaki (2014). Introduction to Economic Zoology. New Central Book Agency (P) Ltd., Kolkata

15. Shukla and Upadhyaya (2002). Economic Zoology, Rastogi Publishers
16. Singh, R. K. P. (2003) Economics of Aquaculture. Daya Publishing House
17. Yadav, Manju (2003). Economic Zoology. 1st Ed. Discovery Publishing House.



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(MAJOR COURSE)

UG SEMESTER-VI

MAJOR CORE COURSE NO.	:	UMJZOT603
MAJOR CORE COURSE TITLE	:	ANIMAL BEHAVIOUR AND CHRONOBIOLOGY
CREDITS	:	04 {03 (THEORY) + 01 (Practical)}
MAXIMUM MARKS	:	75
I) External (University Exam)	:	60
II) Internal Assessment	:	15
DURATION OF UNIVERSITY EXAM	:	03 Hours
MAXIMUM MARKS PRACTICALS	:	25
I) Continuous Assessment	:	10
II) Final Examination	:	15

Objectives and Expected Learning Outcomes

This course provides an in-depth exploration of animal behavior and chronobiology. It encompasses the historical foundations and methodological approaches of Ethology, behavior patterns (innate and learned), social interactions, reproductive behaviors, and the principles of chronobiology. Students will delve into the diverse communication patterns among animals and study the intricate aspects of social behavior, reproductive strategies, and the role of biological rhythms in phenomena like bird and fish migration, photoperiod regulation, and the influence of melatonin on circadian rhythms. By the end of this course, students will develop a comprehensive understanding of the complexities within animal behavior, fostering interdisciplinary connections and a profound recognition of the field's significance within the broader scope of biology.

Unit 1: Introduction to Ethology and Methods of Study

(8 hours)

- 1.1 Origin and history of Ethology
- 1.2 Pioneers of Modern Ethology: Karl Von Frish, Ivan Pavlov, Konrad Lorenz, Niko Tinbergen
- 1.3 Proximate and ultimate causes of behaviour
- 1.4 Approaches to study animal behavior in field
 - 1.4.1 Field Studies
 - 1.4.1.1 Behavioural Sampling Methods proposed by Altman
 - 1.4.1.2 Natural and Artificial Markings for Identification of Animals in wild
 - 1.4.1.3 Animal Tracking methods



Unit 2: Patterns of Behaviour**(15 hours)**

- 2.1 Definition and types of Behaviour: Innate (Stereotyped) and Learned (Acquired)
 - 2.1.1 Orientation (Kinesis, Taxis and their types)
 - 2.1.2 Reflexes: types, path and characteristics
 - 2.1.3 Instinctive Behaviour (Fixed Action Patterns), Properties and Sign/Key Stimulus/Releasers
 - 2.1.4 Motivation
 - 2.1.5 Learning: Associative learning (classical and instrumental conditioning) Habituation and Imprinting
- 2.2 Difference between Instinctive and Learned Behaviour
- 2.3 Communication Patterns: Visual, Auditory, Chemical, Tactile

Unit 3: Social and Reproductive Behaviour**(12 hours)**

- 3.1 Social behaviour
 - 3.1.1 Concept of Social behaviour (Solitary, Pair, Family, Harem, Matriarchy, Oligarchy, Arena, Hierarchy, Aggregation and Caste System)
 - 3.1.2 Altruistic behaviour
 - 3.1.3 Aggression and Territoriality
 - 3.1.4 Social organization in Insects
- 3.2 Reproductive behaviour and parental care
 - 3.2.1 Sexual asymmetry and sexual dimorphism
 - 3.2.2 Mating systems
 - 3.2.3 Courtship behaviour in animals
 - 3.2.4 Concept of Parental care in animals with special reference to amphibians

Unit 4: Chronobiology**(10 hours)**

- 4.1 Biological oscillation: the concept of Average, amplitude, phase and period.
- 4.2 Biological rhythms and types (Circannual, Circadian, tidal/lunar, ultradian, infradian rhythms, Epicycles, Zeitgebers)
- 4.3 Bird Migration and Navigation
- 4.4 Fish Migration
- 4.5 Photoperiod and regulation
- 4.6 Role of melatonin in circadian rhythms

Practicum**(30 hours)**

1. To study nests and nesting habits of the birds and social insects.
2. To study the phototaxis behaviour in insect larvae/earthworm/pests.
3. To study geotaxis behaviour in earthworm or Pests.



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4. To study the food preference in *Tribolium* or any other grain/pulse pest.
5. To study the thigmotrophism, thermotaxis and chemotaxis in *Paramecium* or other zooplanktons
6. Visit to Forest/ Wild life Sanctuary/Biodiversity Park/Zoological Park to study behavioural activities of Rhesus monkeys or Langurs.
7. To study web construction and habituation in Spider
8. Study of circadian functions in humans (daily eating, sleep and temperature patterns).

NOTE FOR PAPER SETTING

Examination Theory /Practical	Syllabus to be Covered in Examination	Time allotted for Exam	Marks
Internal Theory Assessment	50%	1Hr& 30 Minutes	15
External Theory End Semester	100%	3Hrs	60
Continuous assessment	-	-	10 (Based on Daily Performance only)
Final Examination	-	-	15

External End Semester Theory Examination will have two sections (A&B) {Total marks 60}

Section A: Four short answer questions representing all units/syllabi i.e., one question from each unit. Each question shall be of 3 marks.

Section B: Eight long answer questions (Four to be attempted) representing whole of the syllabi i.e., two questions from each unit. Each question shall be of 12 marks.

Internal Assessment {Total marks 15}

Fifteen (15) marks for theory paper in a subject reserved for internal assessment shall have one long answer type question of 7 marks and four short answer type questions of 2 marks each.

Recommended Readings:

1. D.S. Saunders, C.G.H. Steel, X, Afopoulou (ed.) R.D. Lewis. (2002). Insect Clocks (3rd Ed), Barends and Noble Inc. New York, USA
2. David McFarland, Animal Behaviour, Pitman Publishing Limited, London, UK.
3. Jay. C. Dunlap, Jennifer. J. Loros, Patricia J. DeCoursey (ed). 2004, Chronobiology Biological Timekeeping: Sinauer Associates, Inc. Publishers, Sunderland, MA, USA
4. John Alcock, Animal Behaviour, Sinauer Associate Inc., USA.
5. M. P. Arora (2012), Animal Behaviour, Himalaya Publishing House Pvt. Ltd, India

6. Manning, A. and Dawkins, M. S, An Introduction to Animal Behaviour, Cambridge, University Press, UK.
7. Paul W. Sherman and John Alcock, Exploring Animal Behaviour, Sinauer Associate Inc., Massachusetts, USA.
8. ReenaMathur (2010), Animal Behaviour, Rastogi Publications, India .
9. Vinod Kumar (2002) Biological Rhythms: Narosa Publishing House, Delhi/ Springer-Verlag, Germany.



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SYLLABI AND COURSE OF STUDY IN ZOOLOGY UNDER
CBCS AS PER NEP - 2020
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(MAJOR COURSE)

UG SEMESTER-VI

MAJOR CORE COURSE NO.	:	UMJZOT604
MAJOR CORE COURSE TITLE	:	BIOCHEMISTRY OF METABOLIC PROCESSES
CREDITS	:	04 {03 (THEORY) + 01 (Practical)}
MAXIMUM MARKS	:	75
I) External (University Exam)	:	60
II) Internal Assessment	:	15
DURATION OF UNIVERSITY EXAM	:	03 Hours
MAXIMUM MARKS PRACTICALS	:	25
I) Continuous Assessment	:	10
II) Final Examination	:	15

Objectives and Expected Learning Outcomes

The course aims to provide a comprehensive understanding of cellular metabolism, encompassing bioenergetics, carbohydrate, amino acid, and lipid metabolism, and biological oxidation. By the course end, students will adeptly explain and analyze metabolic pathways, including energy transformations, molecule breakdown, and disorders, enabling them to comprehend, evaluate, and address biochemical processes in living organisms.

Unit 1: Carbohydrate Metabolism

(15 hours)

- 1.1 High Energy Compounds:
 - 1.1.1 Types of High Energy Compounds and High Energy Bonds
 - 1.1.2 ATP: Structure and importance
- 1.2 Sequence of Reactions and Regulation of Glycolysis
- 1.3 Pentose phosphate pathway
- 1.4 Oxidative decarboxylation
- 1.5 Citric acid cycle and its regulation
- 1.6 Gluconeogenesis, Glycogenolysis, and Glycogenesis

Unit 2: Amino Acid Metabolism

(10 hours)

- 2.1 Catabolism of amino acids: Transamination and Deamination
- 2.2 Metabolism of Ammonia
- 2.3 Urea Cycle



2.4 Common Disorders of Amino Acid metabolism: cause, symptoms and treatment

- 2.4.1 Albinism
- 2.4.2 Alkaptonuria
- 2.4.3 Phenylketonuria

Unit 3: Lipid Metabolism**(10 hours)**

- 3.1 β -oxidation of saturated fatty acids
- 3.2 Ketone bodies: Production, regulation and disorders
- 3.3 Biosynthesis of palmitate and its regulation
- 3.4 Causes, symptoms, management and treatment of the following:
 - 3.4.1 Non-Alcoholic Fatty Liver Disease

Unit 4: Biological oxidation**(10 hours)**

- 4.1 Oxidation, Reduction and Redox Potential
- 4.2 Enzymes & coenzymes involved in Oxidation & Reduction
- 4.3 Mitochondrial respiratory Chain: Components and Oxidative Phosphorylation
- 4.4 Inhibitors and Uncouplers of ETC and Oxidative Phosphorylation

Practicum**(30hours)**

1. Identification of unknown carbohydrates in given solutions (Starch, Sucrose, Lactose, Galactose, Glucose, Fructose).
2. Estimation the concentration of plasma glucose in the given sample by colorimetric / Spectrophotometric method.
3. Effect of pH and temperature on the action of salivary amylase.
4. Estimation of total protein in given solutions by Lowry's method.
5. Estimation of glycogen in the given sample by colorimetric / Spectrophotometric method
6. Determination of saponification value of oil.
7. Determination of iodine number of oil.
8. Detection of amino acids by Ninhydrin method.

NOTE FOR CONDUCTING PRACTICALS (MANDATORY)

Practicals to be conducted mandatorily in separate groups as per UGC guidelines (15-20 students per group) in addition to theory classes.

NOTE FOR PAPER SETTING

Examination Theory/Practical	Syllabus to be Covered in Examination	Time allotted for Exam	Marks
Internal Theory Assessment	50%	1Hr & 30 Minutes	15
External TheoryEnd	100%	3Hrs	60



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Semester Continuous assessment	-	-	10 (Based on Daily Performance only)
Final Examination	-	-	15

External End Semester Theory Examination will have two sections (A&B) {Total marks 60}

Section A: Four short answer questions representing all units/syllabi i.e., one question from each unit. Each question shall be of 3 marks.

Section B: Eight long answer questions (Four to be attempted) representing whole of the syllabi i.e., two questions from each unit. Each question shall be of 12 marks

Internal Assessment {Total marks 15}

Fifteen (15) marks for theory paper in a subject reserved for internal assessment shall have one long answer type question of 7 marks and four short answer type questions of 2 marks each.

Recommended Readings:

1. Berg J. & G. Tomaselli – A Clinical Companion to Accompany Biochemistry –; Freeman & Co
2. Berg J.M., Tymoczko J.L., Stryer L.2007.Biochemistry, VI Edition, W.H.Freeman and Co., New York.
3. Campbell M. K., Farrell S. O. 2012. Biochemistry. 7th Edn, Brooks and Cole.
4. Chatterjee M. N., Shinde R. 2012. A Textbook of Medical Biochemistry. 8th Edn. Jaypee
5. Cox M. M., Nelson D. L. 2008. Lehninger's Principles of Biochemistry, W.H. Freeman & Co., NY
6. Das D. 2000. Biochemistry. NCBA, Kolkata
7. Deb A. C. – Fundamentals of Biochemistry; NCBA
8. Hames B. D, Hooper N. M. 2000. Instant Notes in Biochemistry, II Edition, BIOS Scientific Harper's Illustrated Biochemistry; McGraw Hill
9. Jain J. L, Jain N, Jain S. 1979. Fundamentals of Biochemistry. S. Chand Pub. N. Delhi
10. Murray R. K. et al. 2009. Harper's Illustrated Biochemistry, 28th Edition, McGraw- Hill Co.
11. Sathyanarayana U, Chakrapani. 2002. Biochemistry –Books & Allied ;P Ltd, Kolkata
12. Voet D., Voet J. G. 2004. Biochemistry –3rd edition, 2004, John Wiley & Sons, Inc.

FYUGP (SEMESTER-VI)
TITLE: BIOCHEMISTRY OF METABOLIC PROCESSES
COURSE CODE- UMJZOT604

2025-27

UNIVERSITY OF JAMMU
SYLLABI AND COURSE OF STUDY IN ZOOLOGY UNDER CBCS
AS PER NEP - 2020
(For the Examination to be held in Year 2025, 2026 & 2027)
(MINOR COURSE)

UG SEMESTER-VI

MINOR CORE COURSE NO.	:	UMIZOT605
MINOR CORE COURSE TITLE	:	CHORDATE DIVERSITY
CREDITS	:	04 {03 (THEORY) + 01 (Practical)}
MAXIMUM MARKS	:	75
I) External (University Exam)	:	60
II) Internal Assessment	:	15
DURATION OF UNIVERSITY EXAM	:	03 Hours
MAXIMUM MARKS PRACTICALS	:	25
I) Continuous Assessment	:	10
II) Final Examination	:	15

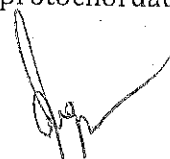
Objectives and Expected Learning Outcomes

The course aims to provide students with a comprehensive understanding of chordates and their diversity, encompassing the classification and distinguishing characteristics of chordates, protochordates, advanced vertebrates, and tetrapods, including amphibians, reptiles, birds, and mammals. Students will explore the evolutionary history, habitat, and morphology of these diverse groups, allowing them to appreciate the significant concepts related to chordate origins, aquatic adaptations, and adaptive radiations in mammals and birds. By the end of the course, students will have a solid foundation in the life and diversity of chordates, enabling them to recognize, classify, and comprehend the ecological and evolutionary aspects of these organisms.

Unit 1: Chordata: Protochordates (Acrania)

(10 hours)

- 1.1 General Characters and outline classification of Chordata up to class level
- 1.2 Protochordata
 - 1.2.1 General characteristics, classification and affinities of Hemichordata, Urochordata and Cephalochordata
 - 1.2.2 Habit-habitat and External morphology of
 - 1.2.2.1 *Balanoglossus*
 - 1.2.2.2 *Herdmania*.
 - 1.2.2.3 *Branchiostoma* (Amphioxus)
 - 1.2.3 Study of larval forms in protochordates



- 1.2.4 Retrogressive metamorphosis in Urochordata
1.3 Origin of Chordata: Dipleurula concept and the Echinoderm theory of origin of chordates

Unit 2: Introduction to Vertebrates (Craniata): Agnatha and Pisces (12 hours)

- 2.1 Advanced features of vertebrates over Protochordata
2.2 Agnatha
2.2.1. General characters and classification of cyclostomes up to order level
2.2.2. Structural peculiarities and affinities of *Petromyzon* and *Myxine*.
2.3 Pisces
2.3.1 General characteristics of Chondrichthyes and Osteichthyes, classification upto order level
2.3.2 Habit-habitat and External morphology of *Scoliodon*
2.3.3 Habit-habitat, External morphology and Evolutionary significance of *Latimeria*
2.3.4. Scales in Fishes
2.3.5 Lateral line system in Fishes
2.3.6 Swim Bladder: Type, Structure and Functions
2.3.7 Osmoregulation in Fishes

Unit 3: Tetrapoda: Amphibians and Reptiles (10 hours)

- 3.1 Origin of Tetrapoda (Evolution of terrestrial ectotherms)
3.2 Amphibia
3.2.1 General characters and classification up to order level
3.2.2 Habit-habitat, External morphology of *Rana tigrina*
3.2.3 Neoteny and Paedogenesis in Amphibia
3.3 Reptilia
3.3.1 General characters and classification up to order level
3.3.2 Habit-habitat, External morphology of *Hemidactylus flaviviridis*
3.3.3 *Sphenodon*: Morphology and evolutionary significance
3.3.4 Poison apparatus and Biting mechanism in snakes
3.3.5 Identification of poisonous and non-poisonous snakes

Unit 4: Tetrapoda: Birds and Mammals (13 hours)

- 4.1 Aves
4.1.1 General characters and classification up to order level
4.1.2 Habit-habitat, External morphology of *Columba livia*
4.1.3 *Archaeopteryx*- a missing link
4.1.4 Feather and their types in Birds
4.1.5 Flight adaptations in Birds
4.2 Mammals
4.2.1 General characters and classification up to order level

- 4.2.2 Habit-habitat, External morphology of *Oryctolagus*
 4.2.3 Aquatic adaptations in Mammals
 4.2.4 Adaptive radiation in Mammals with reference to locomotory appendages

Practicum

1. Study of diverse type of chordates through museum specimens/charts/photographs (30 hours)

- a) **Protochordata:** *Balanoglossus, Herdmania, Branchiostoma, Salpa*
 b) **Agnatha:** *Petromyzon, Myxine, Ammocoetus larva*
 c) **Fishes:** *Scoliodon, Sphyrna, Stegostoma, Pristis, Torpedo, Trygon, Chimaera, Protopterus, Salmo, Clarias, Mystus, Heteropneustes, Ophiocephalus, Labeo, Exocoetus, Echeuis, Anguilla, Hippocampus, Tetodon/Diodon, Anabas, Pterois*
 d) **Amphibia:** *Ichthyophis/Ureotyphlus, Ambystoma, Axolotl larva, Necturus, Salamandra, Rana, Bufo, Hyla, Alytes*
 e) **Reptilia:** *Chelone, Trionyx, Kachuga, Testudo, Sphenodon, Hemidactylus, Varanus, Uromastix, Chamaeleon, Ophiosaurus, Draco, Typhlops, Python, Boa, Bungarus, Vipera russeli, Naja, Hydrophis, Bungarus, Ptyas mucosa, Crocodylus, Gavialis*
 f) **Aves:** *Penguin, Struthio, Eudynamys, Psittacula, Coracias benghalensis, Passer domesticus, Corvus splendens, Anser indicus, Pavo cristatus*
 g) **Mammalia:** *Echidna, Macropus, Talpa, Pteropus giganteus, Desmodus, Armadillo, Manis, Loris, Funambulus, Herpestes, Erinaceus, Balaenoptera musculus, Platanista gangetica, Dugong, Hyaena hyaena, Panthera leo, Panthera pardus, Panthera tigris, Panthera uncia, Acinonyx jubatus, Elephus maximus, Equus, Rhinoceros unicornis, Hippocampus, Sus scrofa, Axis axis*
 h) **2. Study of temporary/permanent mounts of the following:**
 i) Sections of *Amphioxus* through pharyngeal, intestinal and caudal regions.
 j) Weberian ossicles
 k) Ampullae of Lorenzini
 3. Key for Identification of poisonous and non-poisonous snakes
 4. Types of beaks, claws and feathers in birds

NOTE FOR CONDUCTING PRACTICALS (MANDATORY)

Practicals to be conducted mandatorily in separate groups as per UGC guidelines (15-20 students per group) in addition to theory classes.

NOTE FOR PAPER SETTING

Examination Theory/Practical	Syllabus to be Covered in Examination	Time allotted for Exam	Marks
Internal Theory Assessment	50%	1Hr & 30 Minutes	15
External Theory End Semester	100%	3Hrs	60

Continuous assessment	-	-	10 (Based on Daily Performance only)
Final Examination	-	-	15

External End Semester Theory Examination will have two sections(A&B) {Total marks 60}

Section A: Four short answer questions representing all units/syllabi i.e., one question from each unit. Each question shall be of 3 marks.

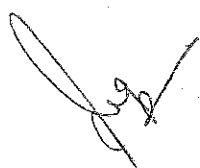
Section B: Eight long answer questions (Four to be attempted) representing whole of the syllabi i.e., two questions from each unit. Each question shall be of 12 marks

Internal Assessment {Total marks 15}

Fifteen (15) marks for theory paper in a subject reserved for internal assessment shall have one long answer type question of 7 marks and four short answer type questions of 2 marks each.

Recommended Readings:

1. Agarwal VK (2011) Zoology for degree students. S. Chand, New Delhi.
2. Arora MP (2006) Chordata-1. 1st Edition. Himalaya Publishing House, New Delhi.
3. Hall BK and Hallgrimsson B (2008) Strickberger's Evolution. 4th Edition. Jones and Bartlett Publishers Inc., USA.
4. Hickman, C P. (2003). Animal Diversity 3rd ed. McGraw-Hill Higher Education
5. Jordan EL and Verma PS. Chordate Zoology. S. Chand, New Delhi.
6. Karedong, K. 2006. Vertebrates 4th ed. Comparative anatomy, function and evolution, McGraw-Hill International edition
7. Kotpal R.L. (2002). Vertebrata, Rastogi Publications, Meerut
8. Nigam. H.C. (2003) Zoology of Chordates, Vishal publications, Jalandhar.
9. Pough, F.H., et al. (2004). Vertebrate Life, 7th ed. Pearson Education International.
10. Waterman, Allyn J. et al. 2001, Chordate Structure and functions. Mac.Millan and Co., New York.
11. Young JZ (2004) The Life of Vertebrates. 3rd Edition. Oxford University Press, USA.



UNIVERSITY OF JAMMU

SYLLABI AND COURSE OF STUDY IN ZOOLOGY

For the Examination to be held in Year 2025, 2026 & 2027

ZOOLOGY COURSE

UG SEMESTER VII

UNDER NEP-2020



University of Jammu
Syllabi of Zoology for FYUGP under CBCS as per NEP-2020
SEMESTER-VII
(Examination to be held in 2025, 2026, 2027)

Course Code: **UMJZOT701**
Credits: 04 {03(Theory) + 01(Practical)}
Practical: 30 hours
Maximum Marks: 100
Theory: 75
Practical/Tutorial: 25

Major Course
Course Title: **RESEARCH METHODOLOGY AND ETHICS**
Total no. of lectures: Theory: 45 hours

Course Code: **UMJZOT702**
Credits: 04 {03(Theory) + 01(Practical)}
Practical: 30 hours
Maximum Marks: 100
Theory: 75
Practical/Tutorial: 25

Major Course
Course Title: **DEVELOPMENTAL BIOLOGY**
Total no. of lectures: Theory: 45 hours

Course Code: **UMJZOT703**
Credits: 04 {03(Theory) + 01(Practical)}
Practical: 30 hours
Maximum Marks: 100
Theory: 75
Practical/Tutorial: 25

Major Course
Course Title: **BASIC ENDOCRINOLOGY**
Total no. of lectures: Theory: 45 hours

Course Code: **UMJZOT704**
Credits: 04 {03(Theory) + 01(Practical)}
Practical: 30 hours
Maximum Marks: 100
Theory: 75
Practical/Tutorial: 25

Major Course
Course Title: **BIOSYSTEMATICS AND TAXONOMY**
Total no. of lectures: Theory: 45 hours

Course Code: **UMIZOT705**
Credits: 04 {03(Theory) + 01(Practical)}
Practical: 30 hours
Maximum Marks: 100
Theory: 75
Practical/Tutorial: 25

Minor Course
Course Title: **BIOLOGICAL CLASSIFICATION
AND SYSTEMATICS**
Total no. of lectures: Theory: 45 hours



UNIVERSITY OF JAMMU
SYLLABI AND COURSE OF STUDY IN ZOOLOGY
UNDER CBCS AS PER NEP - 2020
(For the Examination to be held in Year 2025, 2026 & 2027)
(MAJOR COURSE)

MAJOR CORE COURSE NO.	:	UMJZOT701
MAJOR CORE COURSE TITLE	:	RESEARCH METHODOLOGY AND ETHICS
CREDITS	:	04 {03 (Theory) + 01 (Practical)}
MAXIMUM MARKS	:	75
I) External (University Exam)	:	60
II) Internal Assessment	:	15
DURATION OF UNIVERSITY EXAM	:	03 Hours
MAXIMUM MARKS PRACTICALS:	:	25
I) Continuous assessment	:	10
II) Final examination	:	15

OBJECTIVES AND EXPECTED LEARNING OUTCOMES

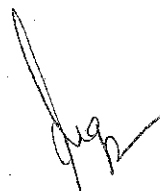
After successful completion of the course the students will have knowledge about research formulation, thesis and paper writing and will have awareness about the publication ethics and publication misconducts.

UNIT-1: FUNDAMENTALS OF RESEARCH (13 HOURS)

- 1.1 Research: concept and Objectives.
- 1.2 Types of research: Descriptive vs. Analytical, Applied vs. Fundamental, Quantitative vs. Qualitative, Conceptual vs. Empirical
- 1.3 Research methodology.
 - 1.3.1 Defining and formulating the research problem.
- 1.4 Selecting the problem - Necessity of defining the problem.

UNIT-2: RESEARCH FORMULATION (10 HOURS)

- 2.1 Literature review: methods of writing review of literature
 - 2.1.1 Primary and secondary sources of review of literature
 - 2.1.2 Reviews & treatise.
 - 2.1.3 Monographs
- 2.2 Patents and its significance.
 - 2.2.1 Web as a source – searching the web.
 - 2.2.2 Critical literature review.
- 2.3 Identifying gap areas from literature review.
 - 2.3.1 Development of working hypothesis.



UNIT-3: RESEARCH DESIGN AND METHODS

(10 HOURS)

- 3.1 Research design – Basic Principles- Need of research design.
 - 3.1.1 Features of good design.
 - 3.1.2 Observation and Facts and explanation.
- 3.2 Induction, Deduction, Development of Models.
- 3.3 Developing a research plan - Exploration, Description, Diagnosis, Experimentation.
- 3.4 Determining experimental and sample designs.

UNIT-4: THESIS WRITING & ETHICS

(12 HOURS)

- 4.1 Structure and components of scientific reports.
 - 4.1.1 Types of report – Technical reports and thesis – Significance.
 - 4.1.2 Different steps in the preparation.
- 4.2 Ethics with respect to science and research
- 4.3 Intellectual property right (IPR)
 - 4.3.1 Scientific misconducts: Falsification, Fabrication and Plagiarism (FFP).
 - 4.3.2 Selective reporting and misrepresentation of data.
 - 4.3.3 Conflicts of interest - Publication misconduct.
- 4.4 Violation of publication ethics, authorship and contributor ship - Identification of publication misconduct, complaints & appeals and consequences.

PRACTICUM

(30 Hours)

1. Selection and reparation of research topic based on zoology
2. To write review on any relevant topic of zoology
3. Demonstration of difference between research and review paper.
4. Preparation of articles on current topics of zoology.
5. Demonstration of IPR and its significance.
6. To write technical report on any topic of zoology.
7. To write bibliography for research paper.
8. To write acknowledgment in research and review paper.

NOTE FOR PAPER SETTING

Examination Theory/Practical	Syllabus to be covered in Examination	Time allotted for Exam	% weightage (Marks)
Internal Theory Assessment	50%	1 Hr. and 30 Min.	15
External Theory End Semester	100%	3 Hours	60
Continuous assessment	-	-	10 (Based on Daily Performance only)
Final Practical examination	-	-	15



External End Semester Theory Examination will have two sections (A & B) {Total marks 60}

Section A: Four short answer questions representing all units/syllabi i.e., one question from each unit. Each question shall be of 3 marks.

Section B: Eight long answer questions (Four to be attempted) representing whole of the syllabi i.e., two questions from each unit. Each question shall be of 12 marks. Candidates are required to attempt four questions in all, selecting one from each unit.

Internal Assessment {Total marks 15}

Fifteen (15) marks for theory paper in a subject reserved for internal assessment shall have one long answer type question of 7 marks and four short answer type questions of 2 marks each.

RECOMMENDED READINGS

1. David Male, Jonathan Brostoff, David Roth and Ivan Roitt. 2006. Immunology. Mosby, Edinburgh, UK
2. Goldsby, R. A., Kindt, T.J. and Osborne, B.A. 2000. Immunology (4th edn.). W.H. Freeman and Co. NY, USA.
3. Hannigan, B. M., Moore, C. B. T. and Quinn, D. G. 2010. Immunology. Viva Books, New Delhi.
4. Helen Chappel and Mased Harney, 2006. Essentials of Clinical Immunology (5th edn.) Blackwell Scientific Publications
5. Ivan M. Roitt, 2002. Essential of Immunology. ELBS, New Delhi.
6. Khan, F.H. 2009. The Elements of Immunology. Pearson Education. New Delhi.
7. Kuby J, 2000. Immunology (7th edn.). WH Freeman & Co. New York.
8. Parija, S.C. 2023. Textbook of Microbiology and Immunology. 4th Ed. Springer Nature Singapore.
9. Richard Coico and Geoffrey Sunshine. 2009. Immunology: A short course. Wiley-Blackwell, CA, USA
10. Abbas, A.K., Lichtman, A.K and Pober, J.S. 1997. Cellular and Molecular Immunology. W.B. Saunders Co. New York
11. Ashim K. Chakravarty. 1998. Immunology. Tata McGraw-Hill, New Delhi.
12. Chakraborty, A.K. 2006. Immunology and Immunotechnology. Oxford University Press, New Delhi
13. Darla, J, Wise & Gordeon, R. Carter. 2004. Immunology- A Comprehensive Review. Iowa State University Press. A Blackwell Science Co, USA



UNIVERSITY OF JAMMU
SYLLABI AND COURSE OF STUDY IN ZOOLOGY
UNDER CBCS AS PER NEP - 2020
(For the Examination to be held in Year 2025, 2026 & 2027)

(MAJOR COURSE)
UG SEMESTER-VII

MAJOR CORE COURSE NO.	:	UMJZOT702
MAJOR CORE COURSE TITLE	:	DEVELOPMENTAL BIOLOGY
CREDITS	:	04 {03 (Theory) + 01 (Practical)}
MAXIMUM MARKS	:	75
I) External (University Exam)	:	60
II) Internal Assessment	:	15
DURATION OF UNIVERSITY EXAM	:	03 Hours
MAXIMUM MARKS PRACTICALS	:	25
i) Continuous assessment	:	10
ii) Final examination	:	15

OBJECTIVES AND EXPECTED LEARNING OUTCOMES

This course aims to provide a comprehensive understanding of developmental biology, covering topics from the origin and migration of primordial germ cells to specific developmental processes like embryonic induction, neurulation, and organ formation. It includes the study of model organisms such as *Caenorhabditis elegans*, *Drosophila*, amphibians, chick, and mouse. Students will gain insights into the molecular, cellular, and organismal aspects of development, fostering critical thinking and analytical skills in the field of developmental biology.

UNIT-I BASIC DEVELOPMENT BIOLOGY (10 HOURS)

- 1.1 Origin of Primordial Germ Cells and their migration
- 1.2 Gametogenesis: Spermatogenesis, Oogenesis and their regulation.
- 1.3 Ultrastructure of a mammalian Sperm.
- 1.4 Types of egg and egg membranes
- 1.5 Biochemistry and physiology of fertilization, species specific recognition of egg and sperm, acrosome reactions, polyspermy and prevention of polyspermy.
- 1.6 Model organisms in developmental biology (*Caenorhabditis elegans*, *Drosophila*, Amphibians, chick and mouse).

UNIT-II EARLY EMBRYONIC DEVELOPMENT (15 HOURS)

- 2.1 Cleavage: Characteristics, Planes, Patterns, Types and Molecular Mechanism
- 2.2 Blastulation and types of blastulae
- 2.3 Fate maps : Construction, significance and examples of fate maps in Frog, Chick and mouse
- 2.4 Gastrulation:
 - 2.4.1 Cell Movements and formation of germ layers
 - 2.4.2 Gastrulation in Birds and mammals



2.5 Cell Determination and Differentiation

UNIT-III MORPHOGENESIS AND ORGANOGENESIS-I (10 HOURS)

- 3.1 Embryonic Induction and Organizers
- 3.2 Axes and Body pattern formation:
 - 3.2.1 Origin of anterior-posterior and dorsal-ventral polarity in *Drosophila*: Involvement of maternal, segmentation and homeotic genes.
 - 3.2.2 Organization of HOX gene in vertebrates.
 - 3.2.3 Axis formation in Amphibians: Nieuwkoop Centre and Primary Organizer.
 - 3.2.4 Axis formation in birds and mammals: Involvement of pattern forming genes
- 3.3 Neurulation (Establishment of neural tube, Tissue architecture of CNS, cerebral organization, differentiation of neural tube, neurons and neural crest cells)

UNIT-IV MORPHOGENESIS AND ORGANOGENESIS-II (10 HOURS)

- 4.1 Vulva formation in *Caenorhabditis elegans*.
- 4.2 Development of eye and associated developmental Anomalies.
- 4.3 Development of Heart in vertebrates,
- 4.4 Limb development and regeneration in amphibians.
- 4.5 Extra embryonic membranes.
- 4.6 Placenta: Development, significance and different types.
- 4.7 Metamorphosis: Hormonal regulation of amphibian metamorphosis.

PRACTICUM (30 HOURS)

1. To study the Histological sections- mammalian Testis and Ovary
2. To observe spermatozoa in vertebrates
3. To study the whole mounts and sections of developmental stages of frog through permanent
4. Slides/Models: Cleavage stages, blastula, gastrula, neurula, tail-bud stage, tadpole (external and internal gill stages)
5. To study the whole mounts of developmental stages of chick through permanent slides: Primitive streak (13 and 18 hours), 21, 24, 28, 33, 36, 48, 72, and 96 hours of incubation
6. To study the life cycle of *Drosophila melanogaster*.
7. To study regeneration in *Hydra*.
8. To study the effect of Iodine in the metamorphosis of frog.
9. To study the effects of Thyroxine in the metamorphosis of frog

NOTE FOR PAPER SETTING

Examination Theory/Practical	Syllabus to be covered in Examination	Time allotted for Exam	% weightage (Marks)
Internal Theory Assessment	50%	1 Hr. and 30 Min.	15
External Theory End Semester	100%	3 Hours	60
Continuous assessment	-	-	10 (Based on Daily Performance only)
Final Practical examination	-	-	15

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External End Semester Theory Examination will have two sections (A & B) {Total marks 60}

Section A: Four short answer questions representing all units/syllabi i.e., one question from each unit. Each question shall be of 3 marks.

Section B: Eight long answer questions (Four to be attempted) representing whole of the syllabi i.e., two questions from each unit. Each question shall be of 12 marks Candidates are required to attempt four questions in all, selecting one from each unit.

Internal Assessment {Total marks 15}

Fifteen (15) marks for theory paper in a subject reserved for internal assessment shall have one long answer type question of 7 marks and four short answer type questions of 2 marks each.

RECOMMENDED READINGS

- 1 Arora, M. P. 2019. Embryology. Himalayan Publishing House, Mumbai, India
- 2 Balinsky, B.I. and Fabian, B. C. 1981. Introduction to Embryology. Saunders College Pub., Philadelphia
- 3 Gilbert, S.F. 2013. Developmental Biology. 10th Edition, Sinauer Associated Inc., Massachusetts
- 4 Keith L. Moore BA, T. V. N. Persaud MD., Mark G. Torchia, 2019. The Developing Human Clinically Oriented Embryology, Elsevier, Netherlands
- 5 Prakash, G. 2007. Reproductive Biology. Narosa Publication House Pvt. Ltd., New Delhi.
- 6 Sadler, T.W., Tosney, K., Chescheir, N.,C., Imseis, H., Leland, J. and Sadler-Redmond, S.,L. 2011. Langman's Medical Embryology (Longmans Medical Embryology).
- 7 Slack, J. M. W. 2005. Essential Developmental Biology. Blackwell Publishing, Australia.
- 8 Slack, J.M.W. 2012. Essential Developmental Biology. 3rd Ed. Wiley-Blackwell, U.S.A.
- 9 Verma, P. S. and Agarwal, V. K. 2000. Chordate Embryology: Developmental Biology of Chordates and Non-chordates. S. Chand & Co., New Delhi
- 10 Wolpert, L. 2002. Principles of development. Oxford University Press, USA.



UNIVERSITY OF JAMMU
SYLLABI AND COURSE OF STUDY IN ZOOLOGY
UNDER CBCS AS PER NEP - 2020
(For the Examination to be held in Year 2025, 2026 & 2027)

(MAJOR COURSE)
UG SEMESTER-VII

MAJOR CORE COURSE No.	:	UMJZOT703
MAJOR CORE COURSE TITLE	:	BASIC ENDOCRINOLOGY
CREDITS	:	04 {03 (Theory) + 01 (Practical)}
MAXIMUM MARKS	:	75
I) External (University Exam)	:	60
II) Internal Assessment	:	15
DURATION OF UNIVERSITY EXAM	:	03 Hours
MAXIMUM MARKS PRACTICALS	:	25
i) Continuous assessment	:	10
ii) Final examination	:	15

OBJECTIVES AND EXPECTED LEARNING OUTCOMES

This course aims to provide students with a comprehensive understanding of the endocrine system, focusing on the structure, function, and regulation of hormones. Students will gain knowledge about the different endocrine glands, their hormones, and the roles they play in maintaining homeostasis. They will also explore the mechanisms of hormone action and the various diseases that can arise from endocrine dysfunction.

UNIT-I INTRODUCTION TO ENDOCRINOLOGY (8 HOURS)

- 1.1 Chemical messengers and hormone classification
- 1.2 Hormone secretions (apocrine, holocrine, and merocrine)
- 1.3 Mechanism of Hormone Action: The Target Cell Concept, Hormone Receptors, Signal Transduction, Signal Generation, G Protein-Coupled Receptors (GPCR) , Second Messengers
- 1.4 Regulation of hormone secretions – negative and positive and feedback mechanisms

UNIT-II HYPOTHALAMUS, PITUITARY AND PINEAL (15 HOURS)

- 2.1 Hypothalamo-hypophyseal system
 - 2.1.1 General organization, Hypothalamic neurosecretory centres, Median eminence: Structure and function
 - 2.1.2 Hypothalamo-hypophyseal portal system
 - 2.1.3 Hormones from Hypothalamus: Secretion and Functions
 - 2.1.4 Regulation of hypothalamic hormone secretion



- 2.2 Pituitary gland:
 - 2.2.1 Location and structure
 - 2.2.2 Hormones from Adenohypophysis: Secretion, Functions and neural control
 - 2.2.3 Hormones from Pars intermedia and Pars nervosa: Secretion, Functions and Regulation
- 2.3 POMC related peptides
- 2.4 Pineal gland: Physiological actions and regulation of melatonin
- 2.5 Diseases: dwarfism, gigantism, acromegaly, diabetes insipidus

UNIT-III THYROID, PARATHYROID AND PANCREAS (12 HOURS)

- 3.1 Thyroid Gland: Histology, Thyroid hormone biosynthesis, control of secretion and physiological role.
- 3.2 Parathyroid gland: Histology, Physiological functions of Parathormone
- 3.3 Role of Parathormone, Calcitonin and Vitamin D in calcium homeostasis
- 3.4 Endocrine Pancreas: Histology, Insulin and Glucagon: structure, regulation of secretion and physiological actions
- 3.5 GI Tract Hormones: types, source and functions
- 3.6 Diseases: goitre, myxoedema, cretinism, diabetes mellitus (type I and type II)

UNIT-IV ADRENAL GLAND AND GONADS (10 HOURS)

- 4.1 Adrenal Gland: Anatomy and histology
 - 4.1.1 Adrenal Cortex: glucocorticoids and mineralocorticoids, biosynthesis, release and its physiological roles
 - 4.1.2 Adrenal medulla: Catecholamine biosynthesis, release and its physiological roles
- 4.2 Gonads and their Hormones
 - 4.2.1 Testis: Organization, Control of secretion and Physiological roles of androgens, Inhibin
 - 4.2.2 Ovary: Organization, Physiological roles of Estrogen, Progesterone, Relaxin and inhibin
- 4.3 Diseases: Addison's disease, Cushing's syndrome, Male infertility, Cryptorchidism, polycystic ovarian disease, hirsutism, and hyperandrogenism

PRACTICUM

(30HOURS)

- 1. Histology slides of Endocrine glands: Pituitary, Thyroid & Parathyroid, Adrenal, Pancreas, Ovary & Testis
- 2. Study of some hormonal disorders through photographs/charts: dwarfism, gigantism, acromegaly, goitre, myxoedema, cretinism, Cushing's syndrome
- 3. To demonstrate the principle of pregnancy diagnosis by the presence of HCG in urine (Acheim Zondek test)
- 4. Dissection of a suitable vertebrate to show Pituitary, Thyroid, Adrenal, Pancreas and Gonads
- 5. Demonstration of thyroid hormone assay by ELISA
- 6. To study the effect of Thyroxine on the metamorphosis in frog.



NOTE FOR PAPER SETTING

Examination Theory/Practical	Syllabus to be covered in Examination	Time allotted for Exam	% weightage (Marks)
Internal Theory Assessment	50%	1 Hr. and 30 Min.	15
External Theory End Semester	100%	3 Hours	60
Continuous Assessment	-	-	10 (Based on Daily Performance only)
Final Practical Examination	-	-	15

External End Semester Theory Examination will have two sections (A & B) {Total marks 60}
 Section A: Four short answer questions representing all units/syllabi i.e., one question from each unit. Each question shall be of 3 marks.

Section B: Eight long answer questions (Four to be attempted) representing whole of the syllabi i.e., two questions from each unit. Each question shall be of 12 marks Candidates are required to attempt four questions in all, selecting one from each unit.

Internal Assessment {Total marks 15}

Fifteen (15) marks for theory paper in a subject reserved for internal assessment shall have one long answer type question of 7 marks and four short answer type questions of 2 marks each.

RECOMMENDED READINGS

1. Barrington, E.J.W. 1985. An introduction to general and comparative endocrinology. Clarendon Press Oxford.
2. Bentley, P.J. 1985. Comparative vertebrate endocrinology, Second Edition, Cambridge University Press. Cambridge.
3. Goswami, M. P. 2013. Endocrinology and Molecular Cell Biology. Pearl Books, India
4. Hadley, M.C. 2000. Endocrinology, Prentice Hall, International, USA
5. Jameson, J. L. 2013. Harrison's Endocrinology. McGraw Hill Education, USA
6. Norris, D. O., and Carr, J. A. (2012). Vertebrate Endocrinology, 5th Edition. Academic Press.
7. Shlomo Melmed, Kenneth S. Polonsky, P. Reed Larsen, Henry M. Kronenberg. 2011. Williams Textbook of Endocrinology E-Book. Elsevier Health Sciences
8. Turner, C.D. and J.T. Bangara. 1986. General endocrinology. Saunders International Student edition, Toppan Company Limited. Tokyo.



UNIVERSITY OF JAMMU
SYLLABI AND COURSE OF STUDY IN ZOOLOGY
UNDER CBCS AS PER NEP - 2020
(For the Examination to be held in Year 2025, 2026 & 2027)

(MAJOR COURSE)
UG SEMESTER-VII

MAJOR CORE COURSE NO.	:	UMJZOT704
MAJOR CORE COURSE TITLE	:	BIOSYSTEMATICS AND TAXONOMY
CREDITS	:	04 {03 (Theory) + 01 (Practical)}
MAXIMUM MARKS	:	75
I) External (University Exam)	:	60
II) Internal Assessment	:	15
DURATION OF UNIVERSITY EXAM	:	03 Hours
MAXIMUM MARKS PRACTICALS	:	25
iii) Continuous assessment	:	10
iv) Final examination	:	15

OBJECTIVES AND EXPECTED LEARNING OUTCOMES

This course provides a thorough exploration of biosystematics and taxonomy, covering historical perspectives, theoretical foundations, and practical applications. Students will learn about taxonomic hierarchy categories, macro-taxonomy schools, species concepts, and the International Code of Zoological Nomenclature. The curriculum includes hands-on skills like organism identification using taxonomic keys, biodiversity evaluation with indices, and an overview of contemporary taxonomy trends. Students will also gain insight into initiatives such as the Barcode of Life and the Global Taxonomic Initiative, culminating in the ability to interpret and construct phylogenetic trees. Overall, the course equips students to classify organisms, identify new species, and understand relationships between different organismal groups.

UNIT-I INTRODUCTION TO BIOSYSTEMATICS AND TAXONOMY (8 HOURS)

- 1.1 Definition and basic concepts of Biosystematics and Taxonomy
- 1.2 History, Theories, Types and Importance of Biological Classification
- 1.3 Taxonomic Hierarchy Categories
- 1.4 Macro-taxonomy and its three schools; Phenetics, cladistics and phylogenetics
- 1.5 Dimension of speciation and species concept
 - 1.5.1 Typological, Nominalistic, Biological, and Evolutionary species concept
 - 1.5.2 Polytypic & monotypic species, subspecies, infraspecific groups, super species and other kind of species.

UNIT-II TAXONOMIC COLLECTIONS AND TAXONOMIC KEYS (12 HOURS)

- 2.1 Collecting ways and data collection
- 2.2 Preservation of collected material and curating
- 2.3 Methods of identification and problems encountered in identification


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- 2.4 Taxonomic characters
- 2.5 Taxonomic keys: Different types of keys – single access keys, diagnostic and synoptic keys, dichotomous and polytomous keys. Taxonomic keys presentation. Computer aided keys. Merits and demerits of keys.
- 2.6 Types of taxonomic publications – atlas, catalogue, checklist, filed guide, field book, hand book, manual, monographs. Zoological records. Ethics in taxonomy.

UNIT-III ZOOLOGICAL NOMENCLATURE

(10 HOURS)

- 3.1 International code of Zoological Nomenclature (ICZN): Operative principles,
- 3.2 Interpretation and application of important rules: Formation of Scientific names of various Taxa.
- 3.3 Synonyms, homonyms and tautonomy
- 3.4 Typification and different Zoological types
- 3.5 Evaluation of biodiversity indices - Shannon-Winner Index, Dominance index, Similarity and dissimilarity index and Association Index.

UNIT-IV NEW TRENDS IN TAXONOMY, PHYLOGENY AND SYSTEMATICS

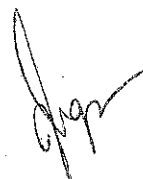
(15 HOURS)

- 4.1 Current approaches in taxonomy: Morphological, Embryological, Ecological, Behavioural, Genetical, Biochemical, Numerical Taxonomy and Differential Systematics.
- 4.2 Bar Code of life – basics of barcoding, application of barcode.
- 4.3 Global taxonomic initiative (GTI)
- 4.4 Cladistic analysis – Apomorphy, Plesiomorphy, Sympleiomorphy and Synapomorphy.
- 4.5 Methodology of cladistics analysis – construction of cladogram.
- 4.6 Significance of phylogenetic systematics.
- 4.7 Phylogenetic trees. Different kinds – cladogram, phenogram, phylogram, dendrogram, curvogram, eurogram, swoopogram, chronogram.

PRACTICUM

(30 HOURS)

1. To study the tools and techniques involved in the museum preservation of specimens.
2. To study the common household insects and list their taxonomic characters.
3. To use the taxonomic keys for identification of the fish of the region, representing different families.
4. To prepare the identification keys for selected specimens of invertebrates (Insects) and vertebrates (Snakes and Birds)
5. Composition assessment of the taxonomic diversity / biodiversity in a habitat (e.g. grassland, arid land, wet land, etc.).
6. Influence of climatic conditions on taxonomic diversity in a given habitat.
7. Preparation of models showing the status of certain taxa or species in a particular habitat.



NOTE FOR PAPER SETTING

Examination Theory/Practical	Syllabus to be covered in Examination	Time allotted for Exam	% weightage (Marks)
Internal Theory Assessment	50%	1 Hr. and 30 Min.	15
External Theory End Semester	100%	3 Hours	60
Continuous assessment	-	-	10 (Based on Daily Performance only)
Final Practical examination	-	-	15

External End Semester Theory Examination will have two sections (A & B) {Total marks 60}
 Section A: Four short answer questions representing all units/syllabi i.e., one question from each unit. Each question shall be of 3 marks.

Section B: Eight long answer questions (Four to be attempted) representing whole of the syllabi i.e., two questions from each unit. Each question shall be of 12 marks. . Candidates are required to attempt four questions in all, selecting one from each unit

Internal Assessment {Total marks 15}

Fifteen (15) marks for theory paper in a subject reserved for internal assessment shall have one long answer type question of 7 marks and four short answer type questions of 2 marks each.

RECOMMENDED READINGS

1. Ashok Verma 2017. Principles of Animal Taxonomy. Narosa Publishing home Pvt. Ltd.
2. Balckwelder, R. C. 1967. Taxonomy- A text and reference book. John wiley and Sons Inc
3. Barrington, E. J. W. 2012. Invertebrate Structure and Functions. Affiliated east-west press Pvt. Ltd. New Delhi
4. Dalela, R.C and R. S Sharma (1992) Animal Taxonomy. Jaiprakashnath Co., Meerut .
5. David, M. H, Craig Moritz and K.M. Barbara.1996. Molecular Systematics. Sinauer Associates, Inc.
6. Hills, D. M., Moritz, C. and Mable, B. K (eds.) (1996) Molecular Systematics, Sinauer Associates, Sunderland , MA
7. Kapoor, V.C. 2017. *Theory and Practice of Animal Taxonomy*. 8th edition, Oxford and IBH Publishing Co., Pvt. Ltd. New Delhi.
8. Margulis, Lynn and M. J. Chapman 2001. *Kingdoms and Domains: An Illustrated Guide to the Phyla of Life on Earth*(4th edn.). W.H.Freeman&Company,USA
9. Mayer, E.2014. *Principles of Systematic Zoology*. 2nd edition, McGraw Hill Book Company, Inc., NY.
10. Minelli, A. (1993) Biological Systematics. Chapman & Hall, London ,
11. Narendran, T.C. 2008. *An introduction to Taxonomy*. Zoological survey of India.
12. Ross, H. H. (1974) Biological Systematics. Addison - Wesley Publishing Company, Inc., London.
13. Simson G. G. 2012. Principles of animal taxonomy. Scientific publishers, India.
14. Winston, J.E.2000. *Describing species: Practical Taxonomic Procedures for Biologists*. Columbia University Press,Columbia, USA

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UNIVERSITY OF JAMMU
SYLLABI AND COURSE OF STUDY IN ZOOLOGY
UNDER CBCS AS PER NEP - 2020
(For the Examination to be held in Year 2025, 2026 & 2027)

(MINOR COURSE)
UG SEMESTER-VII

MINOR CORE COURSE NO.	:	UMIZOT-705
MINOR CORE COURSE TITLE	:	BIOLOGICAL CLASSIFICATION AND SYSTEMATICS
CREDITS	:	04 {03 (Theory) + 01 (Practical)}
MAXIMUM MARKS	:	75
I) External (University Exam)	:	60
II) Internal Assessment	:	15
DURATION OF UNIVERSITY EXAM	:	03 Hours
MAXIMUM MARKS PRACTICALS	:	25
i) Continuous assessment	:	10
ii) Final examination	:	15

OBJECTIVES AND EXPECTED LEARNING OUTCOMES

This course provides a thorough exploration of biosystematics and taxonomy, covering historical perspectives, theoretical foundations, and practical applications. Students will learn about taxonomic hierarchy categories, macro-taxonomy schools, species concepts, and the International Code of Zoological Nomenclature. The curriculum includes hands-on skills like organism identification using taxonomic keys, biodiversity evaluation with indices, and an overview of contemporary taxonomy trends. Students will also gain insight into initiatives such as the Barcode of Life and the Global Taxonomic Initiative, culminating in the ability to interpret and construct phylogenetic trees. Overall, the course equips students to classify organisms, identify new species, and understand relationships between different organismal groups.

UNIT-I INTRODUCTION TO BIOSYSTEMATICS AND TAXONOMY (8 HOURS)

- 1.1 Definition and basic concepts of Biosystematics and Taxonomy
- 1.2 History, Theories, Types and Importance of Biological Classification
- 1.3 Taxonomic Hierarchy Categories
- 1.4 Macro-taxonomy and its three schools; Phenetics, cladistics and phylogenetics
- 1.5 Dimension of speciation and species concept
 - 1.5.1 Typological, Nominalistic, Biological, and Evolutionary species concept
 - 1.5.2 Polytypic & monotypic species, subspecies, infraspecific groups, super species and other kind of species.

UNIT-II TAXONOMIC COLLECTIONS AND TAXONOMIC KEYS (12 HOURS)

- 2.1 Collecting ways and data collection
- 2.2 Preservation of collected material and curating
- 2.3 Methods of identification and problems encountered in identification



FYUGP (SEMESTER-VII) | 2025-2027

TITLE-BIOLOGICAL CLASSIFICATION AND SYSTEMATICS
COURSE CODE- UMIZOT 705

- 2.4 Taxonomic characters
- 2.5 Taxonomic keys: Different types of keys – single access keys, diagnostic and synoptic keys, dichotomous and polytomous keys. Taxonomic keys presentation. Computer aided keys. Merits and demerits of keys.
- 2.6 Types of taxonomic publications – atlas, catalogue, checklist, field guide, field book, hand book, manual, monographs. Zoological records. Ethics in taxonomy.

UNIT-III ZOOLOGICAL NOMENCLATURE (10 HOURS)

- 3.1 International code of Zoological Nomenclature (ICZN): Operative principles,
- 3.2 Interpretation and application of important rules: Formation of Scientific names of various Taxa.
- 3.3 Synonyms, homonyms and tautonomy
- 3.4 Typification and different Zoological types
- 3.5 Evaluation of biodiversity indices - Shannon-Winner Index, Dominance index, Similarity and dissimilarity index and Association Index.

UNIT-IV NEW TRENDS IN TAXONOMY, PHYLOGENY AND SYSTEMATICS (15 HOURS)

- 4.1 Current approaches in taxonomy: Morphological, Embryological, Ecological, Behavioural, Genetical, Biochemical, Numerical Taxonomy and Differential Systematics.
- 4.2 Bar Code of life – basics of barcoding, application of barcode.
- 4.3 Global taxonomic initiative (GTI)
- 4.4 Cladistic analysis – Apomorphy, Plesiomorphy, Sympleiomorphy and Synapomorphy.
- 4.5 Methodology of cladistics analysis – construction of cladogram.
- 4.6 Significance of phylogenetic systematics.
- 4.7 Phylogenetic trees. Different kinds – cladogram, phenogram, phylogram, dendrogram, curvogram, eurogram, swoopogram, chronogram.

PRACTICUM (30 HOURS)

- 1. To study the tools and techniques involved in the museum preservation of specimens.
- 2. To study the common household insects and list their taxonomic characters.
- 3. To use the taxonomic keys for identification of the fish of the region, representing different families.
- 4. To prepare the identification keys for selected specimens of invertebrates (Insects) and vertebrates (Snakes and Birds)
- 5. Composition assessment of the taxonomic diversity / biodiversity in a habitat (e.g. grassland, arid land, wet land, etc.).
- 6. Influence of climatic conditions on taxonomic diversity in a given habitat.
- 7. Preparation of models showing the status of certain taxa or species in a particular habitat.



FYUGP (SEMESTER-VII) 2025-2027

TITLE-BIOLOGICAL CLASSIFICATION AND SYSTEMATICS
COURSE CODE- UMIZOT 705

NOTE FOR PAPER SETTING

Examination Theory/Practical	Syllabus to be covered in Examination	Time allotted for Exam	% weightage (Marks)
Internal Theory Assessment	50%	1 Hr. and 30 Min.	15
External Theory End Semester	100%	3 Hours	60
Continuous assessment	-	-	10 (Based on Daily Performance only)
Final Practical examination	-	-	15

External End Semester Theory Examination will have two sections (A & B) {Total marks 60}

Section A: Four short answer questions representing all units/syllabi i.e., one question from each unit. Each question shall be of 3 marks.

Section B: Eight long answer questions (Four to be attempted) representing whole of the syllabi i.e., two questions from each unit. Each question shall be of 12 marks. . Candidates are required to attempt four questions in all, selecting one from each unit.

Internal Assessment {Total marks 15}

Fifteen (15) marks for theory paper in a subject reserved for internal assessment shall have one long answer type question of 7 marks and four short answer type questions of 2 marks each.

RECOMMENDED READINGS

1. Ashok Verma 2017. Principles of Animal Taxonomy. Narosa Publishing home pvt. Ltd.
2. Balckwelder, R. C. 1967. Taxonomy- A text and reference book. John wiley and Sons Inc
3. Barrington, E. J. W. 2012. *Invertebrate Structure and Functions*. Affiliated east-west press Pvt. Ltd. New Delhi
4. Dalela, R.C and R. S Sharma (1992) Animal Taxonomy. Jaiprakashnath Co., Meerut .
5. David, M. H, Craig Moritz and K.M. Barbara.1996. *Molecular Systematics*. Sinauer Associates, Inc.
6. Hills, D. M., Moritz, C. and Mable, B. K (eds.) (1996) *Molecular Systematics*, Sinauer Associates, Sunderland , MA
7. Kapoor, V.C. 2017. *Theory and Practice of Animal Taxonomy*. 8th edition, Oxford and IBH Publishing Co., Pvt. Ltd. New Delhi.
8. Margulis, Lynn and M. J. Chapman 2001. *Kingdoms and Domains: An Illustrated Guide to the Phyla of Life on Earth*(4th edn.). W.H.Freeman&Company,USA
9. Mayer, E.2014. *Principles of Systematic Zoology*. 2nd edition, McGraw Hill Book Company, Inc., NY.
10. Minelli, A. (1993) *Biological Systematics*. Chapman & Hall, London ,
11. Narendran, T.C. 2008. *An introduction to Taxonomy*. Zoological survey of India.
12. Ross, H. H. (1974) *Biological Systematics*. Addison - Wesley Publishing Company, Inc., London.
13. Simson G. G. 2012. *Principles of animal taxonomy*. Scientific publishers, India.

UNIVERSITY OF JAMMU

SYLLABI AND COURSE OF STUDY IN ZOOLOGY

For the Examination to be held in Year 2026, 2027 & 2028

ZOOLOGY COURSE

UG SEMESTER VIII (HONOURS)

UNDER NEP-2020



University of Jammu

Syllabi of Zoology for FYUGP under CBCS as per NEP-2020

SEMESTER-VIII (HONOURS)

(Examination to be held in 2026, 2027 & 2028)

Major Course

Course Code: **UMJZOT801**
Credits: 04 {03(Theory) + 01(Practical)}
Practical: 30 hours

Course Title: **ICHTHYOLOGY**

Total no. of lectures: Theory: 45 hours

Maximum Marks: 100

Theory: 75

Practical/Tutorial: 25

Major Course

Course Code: **UMJZOT802**
Credits: 04 {03(Theory) + 01(Practical)}
Practical: 30 hours

Course Title: **BIOINSTRUMENTATION**

Total no. of lectures: Theory: 45 hours

Maximum Marks: 100

Theory: 75

Practical/Tutorial: 25

Major Course

Course Code: **UMJZOT803**
Credits: 04 {03(Theory) + 01(Practical)}
Practical: 30 hours

Course Title: **MICROBIOLOGY**

Total no. of lectures: Theory: 45 hours

Maximum Marks: 100

Theory: 75

Practical/Tutorial: 25

Major Course

Course Code: **UMJZOT804**
Credits: 04 {03(Theory) + 01(Practical)}
Practical: 30 hours

Course Title: **COMPARATIVE ANATOMY OF VERTEBRATES**

Total no. of lectures: Theory: 45 hours

Maximum Marks: 100

Theory: 75

Practical/Tutorial: 25

Minor Course

Course Code: **UMIZOT805**
Credits: 04 {03(Theory) + 01(Practical)}
Practical: 30 hours

Course Title: **FISH BIOLOGY AND DIVERSITY**

Total no. of lectures: Theory: 45 hours

Maximum Marks: 100

Theory: 75

Practical/Tutorial: 25

UNIVERSITY OF JAMMU
SYLLABI AND COURSE OF STUDY IN ZOOLOGY
UNDER CBCS AS PER NEP - 2020
(For the Examination to be held in Year 2026, 2027 & 2028)
(MAJOR COURSE)

MAJOR CORE COURSE NO.	:	UMJZOT 801
MAJOR CORE COURSE TITLE	:	ICHTHYOLOGY
CREDITS	:	04 {03 (Theory) + 01 (Practical)}
MAXIMUM MARKS	:	75
I) External (University Exam)	:	60
II) Internal Assessment	:	15
DURATION OF UNIVERSITY EXAM	:	03 Hours
MAXIMUM MARKS PRACTICALS	:	25
i) Continuous assessment	:	10
ii) Final examination	:	15

OBJECTIVES AND EXPECTED LEARNING OUTCOMES

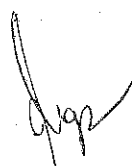
This course immerses students in the captivating world of fishes, covering their classification, morphology, and unique adaptations. It explores distinctive features, geographical distributions, and major fish groups such as Chondrichthyes, Actinopterygii, and Crossopterygii. From the intricacies of digestive, circulatory, and respiratory systems to the fascinating realms of electric organs and bioluminescence, students gain a comprehensive understanding of fish anatomy and physiology. The course also delves into adaptations, fish behavior, migration patterns, social interactions, and sensory perception. By the course's conclusion, students emerge as confident ichthyologists, equipped with knowledge of fish identification, evolution, and function to navigate the underwater world adeptly.

UNIT-I CLASSIFICATION, BODY FORM AND DIVERSITY (10 HOURS)

- 1.1 Outline classification of fishes with special reference to distinctive features, geographical distribution, and typical examples of the sub-divisions: Chondrichthyes, Actinopterygii, Crossopterygii, and Dipnoi
- 1.2 Phylogenetic significance of Ostracoderms and Placoderms
- 1.3 Morphometric and Meristic studies in fishes as a taxonomic tool
- 1.4 Fin structure, types, modification and function, theories of origin of paired fins
- 1.5 Types of scales and development
- 1.6 Colouration in fishes

UNIT-II ANATOMY AND PHYSIOLOGY-I (10 HOURS)

- 2.1 Food, feeding habit and alimentary canal diversification in fishes
- 2.2 Circulatory system: Heart and accessory pumps in fishes
- 2.3 Respiration in Fishes: Structure, modifications and functions of gills
- 2.4 Accessory Respiratory Organs in Fishes
- 2.5 Excretory organs and excretion in fishes



2.6 Osmoregulation in Fishes

UNIT-III ANATOMY AND PHYSIOLOGY-II

(10 HOURS)

- 3.1 Skeletal system - skull, splanchnocranium, jaw suspension and vertebral column.
- 3.2 Swim bladder: Structure, Types and functions
- 3.3 Reproductive organs and Accessory sex organs
- 3.4 Reproductive, Spawning, and Sexual Strategies in Fish
- 3.5 Electric organs: their structure and use in fishes
- 3.6 Bioluminescence in fishes and its significance

UNIT-IV HABITS, ADAPTATIONS AND SPECIFIC BEHAVIOUR IN FISHES

(15 HOURS)

- 4.1 Hill stream, deep sea and Arctic and Antarctic fishes emphasizing on adaptation
- 4.2 Migratory Behavior in fishes
- 4.3 Shoaling in fishes
- 4.4 Nest building and parental Care
- 4.5 Poisonous fishes and their poisonous apparatus
- 4.6 Sensory Perception in Fishes
 - 4.6.1 Photoreception: Eye
 - 4.6.2 Acoustico-lateralis system
 - 4.6.3 Electrorception & Magnetoreception

PRACTICUM

(30 HOURS)

1. Study of Various Body Forms in Fishes
2. Fish Dissections:
 - a. Weberian ossicles of locally available fish
 - b. Dissection of Digestive System of locally available fish
 - c. Dissection of Efferent and Efferent Branchial System in *Wallago/Clarias*/ locally available fish
3. Identification of Indian Common Fish Faunal Resources: Cold water, warm water, brackish water, marine water, and ornamental fishes
4. Study of Various Modifications of Fins: Dorsal, Pectoral, Anal, and Caudal fins
5. Study of Morphometric and Meristic characteristic of Fishes
6. Preparation of Permanent Slides of Scales: Placoid, Cycloid, Ctenoid, Ganoid
7. Visit to Local Fish Seed Production Centre
8. Visit to Fish Aquarium at Bagh-e-Bahu Jammu
9. Use of fish identification key to identify local fishes of J&K

NOTE FOR PAPER SETTING

Examination Theory/Practical	Syllabus to be covered in Examination	Time allotted for Exam	% weightage (Marks)
Internal Theory Assessment	50%	1 Hr. and 30 Min.	15
External Theory End Semester	100%	3 Hours	60

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Continuous assessment	-	-	10 (Based on Daily Performance only)
Final Practical examination	-	-	15

External End Semester Theory Examination will have two sections (A & B) {Total marks 60}

Section A: Four short answer questions representing all units/syllabi i.e., one question from each unit. Each question shall be of 3 marks.

Section B: Eight long answer questions (Four to be attempted) representing whole of the syllabi i.e., two questions from each unit. Each question shall be of 12 marks. . Candidates are required to attempt four questions in all, selecting one from each unit.

Internal Assessment {Total marks 15}

Fifteen (15) marks for theory paper in a subject reserved for internal assessment shall have one long answer type question of 7 marks and four short answer type questions of 2 marks each.

RECOMMENDED READINGS.

1. Gupta and Gupta, 2006. General and applied Ichthyology (Fish and Fisheries) S. Chand and Co. New Delhi
2. Jayaram, K. C. 2017. Fundamentals of fish taxonomy, Narindra Publishing House, Delhi.
3. Jhingran, V.G. 1975. Fish and Fisheries of India. Hindustan Publishing Co., Calcutta.
4. Khanna and Singh, 2003. A textbook of Fish Biology and Fisheries, Narendra Publishing House, India
5. Khanna, S. S. 2006. An Introduction to Fishes. Surjeet Publications, India
6. Kumar, A and Dubey, P. 2006. Fish Management and Aquatic Environment. Daya Publ. House, Delhi.
7. Lagler K.F., Bardach, J. E., Miller, R. R., Passino, D. R. M. 2012. Ichthyology, 2nd Ed. John Wiley & Sons, New York.
8. Lynwood, S. Smith. 2003. Introduction to the fish physiology. Narendra Publ. House, Delhi.
9. Mishra, 1962. Records of Indian Museum an aid to the identification of the common commercial fishes of India and Pakistan, Vol. 5 (Part I-IV)
10. Moyle PB and Joseph J. Cech Jr. 2004. Fishes: An Introduction to Ichthyology. 5 th Ed. Prentice Hall.
11. Norman JR and Greenwood PH. 1975. A History of Fishes, Halsted Press.
12. R.R. Sticking. 2017. Aquaculture introductory (3rd edition), CAB International U.K.
13. Srivastava, C.B.L. 2019. A text book of Fishery Science and Indian Fisheries. Kitab Mahal. India
14. Yadav, B. N. 2016. Fish and Fisheries. Daya Publishing House, Delhi



UNIVERSITY OF JAMMU
SYLLABI AND COURSE OF STUDY IN ZOOLOGY
UNDER CBCS AS PER NEP - 2020
(For the Examination to be held in Year 2026, 2027 & 2028)
(MAJOR COURSE)

MAJOR CORE COURSE NO.	:	UMJZOT802
MAJOR CORE COURSE TITLE	:	BIOINSTRUMENTATION
CREDITS	:	04 {03 (Theory) + 01 (Practical)}
MAXIMUM MARKS	:	75
I) External (University Exam)	:	60
II) Internal Assessment	:	15
DURATION OF UNIVERSITY EXAM	:	03 Hours
MAXIMUM MARKS PRACTICALS	:	25
i) Continuous assessment	:	10
ii) Final examination	:	15

OBJECTIVES AND EXPECTED LEARNING OUTCOMES

This course aims to familiarize students with state-of-the-art instrumentation in biology, covering microscopy, histological techniques, separation techniques, advanced analytical methods, and radiation techniques. Students will gain a comprehensive understanding of microscopy principles, specimen preparation, and histological procedures. The course delves into separation techniques such as centrifugation, chromatography, and gel electrophoresis, providing hands-on experience. Advanced topics include the operation of pH meters, colorimetry, various spectroscopy techniques, DNA sequencing, and the principles of radiochemical techniques. By the end of the course, students will be well-equipped to apply these techniques in their research, ensuring a solid foundation in both theoretical knowledge and practical skills essential for biological research.

UNIT-I MICROSCOPY AND HISTOLOGICAL TECHNIQUES

(12 HOURS)

- 1.1 Microscopy-Principles, types and applications
 - 1.1.1 Light microscopy principles and its types: Bright Field, Dark Field and Phase contrast, Fluorescence microscopy, Confocal microscope
 - 1.1.2 Electron Microscope: TEM, SEM
 - 1.1.3 Scanning Tunnelling microscope
 - 1.1.4 Specimen preparation- Shadow casting, Freeze fracturing, Freeze etching
 - 1.1.5 Different fixation and staining techniques for EM
- 1.2 Histological Techniques
 - 1.2.1 Types of microtomes and microtomy.
 - 1.2.2 Preparation of temporary and permanent slides, whole mounts, smears, squashes and sections.



UNIT-II SEPARATION TECHNIQUES

(13 HOURS)

- 2.1 Centrifugation
 - 2.1.1 Basic principle and application
 - 2.1.2 Differential, density and ultracentrifugation
- 2.2 Chromatography: Basic principles, working and applications of Column chromatography, Ion-exchange chromatography, Affinity chromatography, Paper chromatography, Thin-layer chromatography (TLC), Gas chromatography, High-pressure liquid chromatography (HPLC)
- 2.3 Gel electrophoresis– PAGE, SDS and non SDS, 2D Gel electrophoresis, Isoelectric focusing, Density gradient gel electrophoresis, Capillary gel electrophoresis, Electrophoretic mobility shift assay (EMSA).
- 2.4 Southern Blotting, Western Blotting, Northern Blotting
- 2.5 Flow-cytometry

UNIT-III ADVANCED TECHNIQUES AND APPLICATIONS

(12 HOURS)

- 3.1 pH meter: Operation of pH electrodes, Principles and applications of Ion-selective and gas sensing electrodes, Oxygen electrodes.
- 3.2 Colorimetry: Principle and applications of colorimetry and spectrophotometry- Beer Lambert law
- 3.3 Spectroscopy: UV-Vis Spectroscopy, Fourier-Transform infrared spectroscopy (FTIR), Atomic absorption spectroscopy, Nuclear Magnetic resonance spectroscopy (NMR), Mass spectroscopy
- 3.4 DNA Sequencing Techniques (Sanger Sequencing and Maxam and Gilbert's chemical method) and Introduction to NGS.
- 3.5 Polymerase chain reaction: Principle and applications

UNIT-IV RADIATION TECHNIQUES IN BIOLOGY


(8 HOURS)

- 4.1 Basics of Radiochemical techniques
 - 4.1.1 Isotopes, Radioactive Decay, Units to Measure Radio Activity, Half Life
- 4.2 Carbon dating
- 4.3 Radioactive Labeling
- 4.4 Measurement of Radiation: Geiger Muller Counter, Scintillation Counter, Gamma Counter, Neutron Activation Analysis
- 4.5 Autoradiography – Method and applications.
- 4.6 Principle and applications of Biosensors.

PRACTICUM

(30 HOURS)

1. Study principle and working of Light microscope
2. Study of different components of of pH meter and measurement of pH of water samples.
3. To fix a tissue with Bouin's fixative and stain using haemotoxylin – eosin stain for histochemical studies
4. Preparation of Blocks, section cutting using microtome, and stretching by wax methods and staining of vertebrate tissues by double staining methods
5. Application of spectrophotometer for validation of Beer –Lambert Law
6. Demonstration of PCR



7. Separation of proteins by SDS-PAGE
8. Separation of nucleic acids by Agarose gel electrophoresis
9. Separation of cell organelles by Differential centrifugation.
10. Separation of amino acids by paper and thin layer Chromatography

NOTE FOR PAPER SETTING

Examination Theory/Practical	Syllabus to be covered in Examination	Time allotted for Exam	% weightage (Marks)
Internal Theory Assessment	50%	1 Hr. and 30 Min.	15
External Theory End Semester	100%	3 Hours	60
Continuous assessment	-	-	10 (Based on Daily Performance only)
Final Practical examination	-	-	15

External End Semester Theory Examination will have two sections (A & B) {Total marks 60}

Section A: Four short answer questions representing all units/syllabi i.e., one question from each unit. Each question shall be of 3 marks.

Section B: Eight long answer questions (Four to be attempted) representing whole of the syllabi i.e., two questions from each unit. Each question shall be of 12 marks. Candidates are required to attempt four questions in all, selecting one from each unit.

Internal Assessment {Total marks 15}

Fifteen (15) marks for theory paper in a subject reserved for internal assessment shall have one long answer type question of 7 marks and four short answer type questions of 2 marks each.

RECOMMENDED READINGS

1. Alonso, A., and Arrondo, J.L.R.2006. *Advanced Techniques in Biophysics*.Springer,UK
2. Arora, M. P. 2007. *Biophysics*. Himalaya Publishing House, New Delhi
3. Daniel, M. 1989. Basic biophysics for biologists. Agro-Botanical Publishers, India.
4. Das, D. 1991. *Biophysics and Biophysical Chemistry*. Academic Publishers, Calcutta
5. Ewing, G.W. 1988. Instrumental methods of chemical analysis, McGraw Hill Book Company.
6. Ghatak K.L. 2011. *Techniques and Methods in Biology*. PHI Learning Pvt. Ltd. New Delhi
7. Gupta A. 2009. *Instrumentation and Bio-Analytical Techniques*. PragatiPrakashan, Meerut
8. Keith Wilson and John Walker. 2010. *Principles and techniques of Biochemistry and Molecular Biology*.7th Edition.
9. Narayanan, P. 2000. *Essentials of Biophysics*. New Age International (P) Ltd. Publishers, New Delhi
10. Roy, R.N. 1996. *A Textbook of Biophysics*. New Central Book Agency (P) Ltd. Calcutta

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11. Sandhu, G.S. 1990. *Research Techniques in Biological Sciences*. Anmol Publications, New Delhi
12. Skoog, A., Douglas, J. and Leary, J.J. 1992. *Principles of Instrumental Analysis*. Sanders Golden Sunberst Series, Philadelphia.
13. Srivastava, P.K. 2006. *Elementary Biophysics. An Introduction*. Narosa Publishing House, New Delhi
14. Veerakumari, L. 2006. *Bioinstrumentation*. MJP Publishers, Chennai.
15. Wilson and Walker. 2000. *Practical biochemistry - principles and techniques*. Cambridge University Press.



UNIVERSITY OF JAMMU
SYLLABI AND COURSE OF STUDY IN ZOOLOGY
UNDER CBCS AS PER NEP - 2020
(For the Examination to be held in Year 2026, 2027 & 2028)
(MAJOR COURSE)

MAJOR CORE COURSE No.	:	UMJZOT803
MAJOR CORE COURSE TITLE	:	MICROBIOLOGY
CREDITS	:	04 {03 (Theory) + 01 (Practical)}
MAXIMUM MARKS	:	75
I) External (University Exam)	:	60
II) Internal Assessment	:	15
DURATION OF UNIVERSITY EXAM	:	03 Hours
MAXIMUM MARKS PRACTICALS	:	25
i) Continuous assessment	:	10
ii) Final examination	:	15

OBJECTIVES AND EXPECTED LEARNING OUTCOMES

This course provides a comprehensive understanding of Microbiology, covering historical developments, microbial diversity, and practical applications. Students explore key figures and microbial classification based on morphology. Topics include Bacteriology, Virology, microbial growth, and control, with a focus on applied Microbiology in medical and food contexts, bioremediation, and the role of microbes in various processes. The goal is to equip students with versatile knowledge applicable across diverse fields while emphasizing the historical foundations and practical implications of Microbiology.

UNIT I HISTORY OF MICROBIOLOGY AND MICROBIAL DIVERSITY (8 HOURS)

- 1.1 Historical background of Microbiology: Contribution of Antonie van Leeuwenhoek, Lazzaro Spallanzani, Robert Koch, Joseph Lister, John Tyndall, Edward Jenner, Louis Pasteur, Alexander Fleming
- 1.2 General groups of microbes and their characteristic features - bacteria, (archae, cyanobacteria, actinomycetes), fungi (molds and yeast), and virus.
- 1.3 Classification based on morphology, Gram's staining and culture characteristics.
- 1.4 Classification based on Bergey's Manual of Systematic Bacteriology and Determinative Bacteriology (details of sections not expected)
- 1.5 Classification of viruses-classification based on host, vital morphology and nucleic acid characteristics.



UNIT-II BACTERIOLOGY & VIROLOGY**(12 HOURS)**

- 2.1 Functional Anatomy of Bacterial Cells:
 - 2.1.1 Size, Cell Structure: plasma membrane, cytoplasm, mesosomes, nucleoid, plasmids, cytoplasmic inclusions.
 - 2.1.2 Prokaryotic cell envelope, peptidoglycan structure, Gram positive and negative cell walls.
 - 2.1.3 Components outside the cell wall: capsules, slime layers, pili and fimbriae, flagella and motility.
- 2.2 Characteristics, Habit-habitat, classification, cell structure of Mycoplasmas, Chlamydiae, Rickettsiae
- 2.3 History of Virology, General characteristics, size, and structure of Viruses
- 2.4 Concept and microbiological significance of Viroids, Virusoids, and Prions

UNIT-III MICROBIAL GROWTH AND CONTROL**(10 HOURS)**

- 3.1 Microbial growth
 - 3.1.1 Culture media, Physical and chemical methods of sterilization
 - 3.1.2 Pure Cultures: Isolation and preservation methods, Biochemical and Culture-based Approaches to Identification of microbial strains
 - 3.1.3 Measurement of growth: growth curve of bacterial populations, Batch Culture, Continuous culture (Chemostat, turbidostat).
 - 3.1.4 Physical conditions required for growth.
- 3.2 Control of Microbial Growth
 - 3.2.1 Antibiotics- types, mechanism of action.
 - 3.2.2 Evaluation of antimicrobial agent effectiveness- Phenol coefficient method,
 - 3.2.3 Determination of Minimum Inhibitory Concentration (MIC) and Minimum Bactericidal Concentration (MBC).

UNIT-IV APPLIED MICROBIOLOGY**(15 HOURS)**

- 4.1 Medical Microbiology: Pathogenicity, infection, mode of transmission of Coliform bacteria (*Salmonella typhi*), Mycoplasma, Rickettsiae, Rabies and HIV-AIDS
- 4.2 Food Microbiology: Important microbes involved in spoilage of food - meat, poultry, Fish and sea food, vegetables and milk
- 4.3 Food preservation and milk pasteurization- Principle and methods
- 4.4 Food poisoning
- 4.5 Bioremediation of hydrocarbons, heavy metals and xenobiotics
- 4.6 Role of microbes in mineral cycle
- 4.7 Biofertilizers-Definition, Types (bacterial, Mycorrhizal-fungal, Plants-Azolla); kind of association, mode of application and merits.
- 4.8 Bioleaching – Role of microbes in metal and petroleum recovery



PRACTICUM

(30 HOURS)

1. Sterilization, disinfection and safety in microbiological laboratory.
2. Preparation of culture media:
 - a. Liquid media – nutrient broth , peptone water
 - b. Solid media – Nutrient Agar, MacConkey Agar.
3. Culturing of microorganism – broth culture, pure culture techniques.
4. Types of bacteriophage, bacteria, fungi and algae from the prepared slides / photographs.
5. Collection and microscopic observation of fungus: Bread mold and Coconut mold.
6. Identification of bacteria - staining methods - Gram positive and Gram negative bacteria.
7. Microscopic examination of bacteria in living conditions - Testing of motility- Hanging drop method/ wet mount method
8. Antibiotic sensitivity test- Kirby Bauer method
9. Bacteriological analysis of milk- methylene blue reduction test
10. Isolation of *Rhizobium* from nodules of leguminous plants
11. Study of permanent stained slides - *Neisseria*, *Mycobacterium*, *Clostridium*, *Penicillium*, *Candida*

NOTE FOR PAPER SETTING

Examination Theory/Practical	Syllabus to be covered in Examination	Time allotted for Exam	% weightage (Marks)
Internal Theory Assessment	50%	1 Hr. and 30 Min.	15
External Theory End Semester	100%	3 Hours	60
Continuous Assessment	-	-	10 (Based on Daily Performance only)
Final Practical Examination	-	-	15

External End Semester Theory Examination will have two sections (A & B) {Total marks 60}

Section A: Four short answer questions representing all units/syllabi i.e., one question from each unit. Each question shall be of 3 marks.

Section B: Eight long answer questions (Four to be attempted) representing whole of the syllabi i.e., two questions from each unit. Each question shall be of 12 marks. Candidates are required to attempt four questions in all, selecting one from each unit.

Internal Assessment {Total marks 15}

Fifteen (15) marks for theory paper in a subject reserved for internal assessment shall have one long answer type question of 7 marks and four short answer type questions of 2 marks each.

RECOMMENDED READINGS

1. Ahmed, M. and Basumatary. S.K. 2006. Applied Microbiology. MJP Publishers, Chennai.
2. Ananthanarayanan, R. and JayaramPanikar, C.K. 2013. Text Book of Microbiology. University Press, Hyderabad.
3. Arora,D.R. and Arora,B. 2008. *Text Book of Microbiology*. CBS Publishers and Distributers, New Delhi
4. Atlas RM. 2005. *Principles of Microbiology*. 4th edition. WMT.Brown Publishers.
5. Black, J.G. 1999. Microbiology - Principles and Explorations. John Wiley and Sons Inc. New York.
6. Chakraborty, P. A. 2009. *Text Book of Microbiology*. New Central Book Agency.New Delhi
7. Harma and Kanika 2009. *Manual of Microbiology Tools and Techniques*. Ane Books Pvt. Ltd. New Delhi
8. Ingraham, J. L. and Ingraham, C. A. 2000. *Microbiology* (2nded.). Brooks/Cole-Thomson Learning,MA,USA
9. Kumar, Surinder 2016. Essentials of Microbiology. Jaypee Brothers Medical Publishers (P) Ltd, New Delhi
10. Parker, N., Schneegurt, M., Anh-Hue ThiTu, Forster, B. M., Lister, P. 2016, Microbiology. OpenStax Publishing.
11. Patrick R. Murray, Ken S. Rosenthal, Michael A. Pfaller. 2005. Medical microbiology. Elsevier Mosby , Philadelphia
12. Pelczar M.J., Chan E.C.S. and Krieg N.R. 2010. *Microbiology*. (8th ed). McGraw Hill Book Company.
13. Talaro, Park.,Kathelee, N and Talaro, Arthur. 2002. *Foundations of Microbiology*. McGraw Hill Higher Education, NY
14. Wagner, E, Hewlett, M.J. 2004. Basic Virology, Blackwell Scientific, Oxford
15. Wheelis Mark 2010. *Principles of Modern Microbiology*. Jones and Bartlett Publishers, NY, USA.



UNIVERSITY OF JAMMU
SYLLABI AND COURSE OF STUDY IN ZOOLOGY
UNDER CBCS AS PER NEP - 2020
(For the Examination to be held in Year 2026, 2027 & 2028)
(MAJOR COURSE)

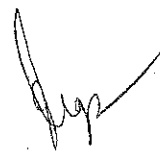
MAJOR CORE COURSE NO.	:	UMJZOT804
MAJOR CORE COURSE TITLE	:	COMPARATIVE ANATOMY OF VERTEBRATES
CREDITS	:	04 {03 (Theory) + 01 (Practical)}
MAXIMUM MARKS	:	75
I) External (University Exam)	:	60
II) Internal Assessment	:	15
DURATION OF UNIVERSITY EXAM	:	03 Hours
MAXIMUM MARKS PRACTICALS	:	25
iii) Continuous assessment	:	10
iv) Final examination	:	15

OBJECTIVES AND EXPECTED LEARNING OUTCOMES

This course offers a comprehensive exploration of comparative anatomy in vertebrates, encompassing the embryonic origin and functions of skin, nervous system organization, musculoskeletal structure, and the digestive, respiratory, circulatory, and excretory systems. Through a comparative lens, students gain a profound understanding of anatomical variations across vertebrate species. The objectives include developing expertise in the comparative analysis of vertebrate anatomy, fostering an appreciation for evolutionary perspectives, and honing critical thinking skills in evaluating anatomical structures. The course outcomes comprise a solid foundation for careers in biology, paleontology, or veterinary sciences, equipping students with essential knowledge for research, evolutionary studies, and diverse applications within the life sciences.

UNIT-1 INTEGUMENTARY AND NEUROSENSORY SYSTEM (17 HOURS)

- 1.1 Vertebrate integument:
 - 1.1.1 Embryonic origin, general structure and function of skin in vertebrates
 - 1.1.2 Phylogeny of integument in vertebrates:
 - 1.1.2.1 Integument in fishes and specialized derivatives (dermal scales & body armor, glands, photophores)
 - 1.1.2.2 Integument in Tetrapods and specialized derivatives (scales, glands, claws & hooves, horns & antlers, feathers & hair)
- 1.2 Nervous system
 - 1.2.1 General organization of the nervous system in animals
 - 1.2.2 Comparative account of brain and evolution of telencephalon
 - 1.2.3 Cranial nerves of vertebrates
 - 1.2.4 Comparative account of vertebrate Sense organs-Eyes, ears, olfactory organs



FYUGP (SEMESTER-VIII) (HONOURS)
TITLE- COMPARATIVE ANATOMY OF VERTEBRATES
COURSE CODE- UMJZOT804

2026-2028

UNIT-II MUSCULOSKELETAL SYSTEM (10 HOURS)

- 2.1 Skeletal components of the head and neck
 - 2.1.1 Evolution of cranial skeleton (Splanchnocranium, Chondrocranium, Dermatocranium)
 - 2.1.2 Evolution of visceral arches
 - 2.1.3 Origin and types of Jaw suspension in vertebrates
- 2.2 Comparative anatomy of vertebral column in vertebrates
- 2.3 Vertebrate limbs: development and comparative structure in different vertebrate groups
- 2.4 Muscle types and organization of skeletal muscles

UNIT-III DIGESTIVE AND RESPIRATORY SYSTEM (9 HOURS)

- 3.1 Digestive System
 - 3.1.1 General organization and comparative account of alimentary canal and digestive glands in vertebrates (Salivary glands, Liver and Pancreas).
 - 3.1.2 Dentition in Vertebrates
- 3.2 Respiratory System
 - 3.2.1 Gills: Types and structural variations and adaptations among vertebrates
 - 3.2.2 Lungs and their evolution from amphibians to mammals.
 - 3.2.3 Accessory Respiratory Organs in Vertebrates:
 - 3.2.3.1 Swim Bladder in fishes
 - 3.2.3.2 Air Sacs in birds

UNIT-IV CIRCULATORY AND EXCRETORY SYSTEM (9 HOURS)

- 4.1 Heart of vertebrates-origin and evolutionary modifications among vertebrate classes
- 4.2 Evolution and modification of major aortic and venous channels of vertebrates.
- 4.3 Vertebrate Kidneys: Gross anatomy, Types, development and evolution
- 4.4 Evolution of Urinogenital ducts in vertebrates

PRACTICUM (30 HOURS)

1. To study the following through permanent slides/charts/models/audio video aids:
 - a. Heart and circulatory system of fish, frog, lizard, pigeon, rabbit
 - b. Blood cell types of vertebrate representatives.
 - c. Skin of vertebrate representatives through permanent slides.
2. To study the Locomotory organs of fish.
3. Preparation of permanent mounts of the following:
 - a. Velum, Oral hood and Pharyngeal region of Amphioxus
 - b. Ampullae of Lorenzini
 - c. Scales in fishes: Placoid, Cycloid and Ctenoid scale
4. Study of shell of turtles and tortoises
5. Study of following skeleton:
 - a. Skull of Fowl / Rabbit
 - b. Axial and Appendicular skeleton of Fowl / Rabbit
6. To dissect out a locally available fish for the study of its:
 - a. Gill structure
 - b. Digestive system
 - c. Pituitary

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FYUGP (SEMESTER-VIII) (HONOURS)
TITLE- COMPARATIVE ANATOMY OF VERTEBRATES
COURSE CODE- UMJZOT804

2026-2028

- d. Weberian ossicles
 7. Study of types of feet and claws, feathers and beaks in birds.

NOTE FOR PAPER SETTING

Examination Theory/Practical	Syllabus to be covered in Examination	Time allotted for Exam	% weightage (Marks)
Internal Theory Assessment	50%	1 Hr. and 30 Min.	15
External Theory End Semester	100%	3 Hours	60
Continuous assessment	-	-	10 (Based on Daily Performance only)
Final Practical examination	-	-	15

External End Semester Theory Examination will have two sections (A & B) {Total marks 60}

Section A: Four short answer questions representing all units/syllabi i.e., one question from each unit. Each question shall be of 3 marks.

Section B: Eight long answer questions (Four to be attempted) representing whole of the syllabi i.e., two questions from each unit. Each question shall be of 12 marks. Candidates are required to attempt four questions in all, selecting one from each unit.

Internal Assessment {Total marks 15}

Fifteen (15) marks for theory paper in a subject reserved for internal assessment shall have one long answer type question of 7 marks and four short answer type questions of 2 marks each.

RECOMMENDED READINGS

1. Barnes, R.S.K. (1993) The invertebrates: a new synthesis, Blackwell Scientific Publication.
2. Cleveland, H.P., Roberts, Larry S. (Jr) and Larson A. (1995) Integrated Principles of Zoology, 9th edition, WBC Brown publishers.
3. Gardiner, M.S. (1972) The Biology of Invertebrates, Mc.GrawHill Book Co.
4. Hyman L.H. (2004) Anatomy of Comparative Vertebrates. Reprint. Satish Serial Publishing, Delhi.
5. Kenneth, V.K. (2006) Vertebrates: Comparative Anatomy, Function, Evolution. 4th edition, McGraw-Hill, New York, NY.
6. Kulshrestha, S.K. (2004) Comparative Anatomy of Vertebrates
7. Milton, H. (1995) Analysis of vertebrate structure. John Niley & Sons Inc, New York.
8. Romer, A.S and Parsons T. S. (1978) The Vertebrate body, 5th edition, W.B. Saunders Co & Toppan Co, Ltd
9. Saxena, R.K. and Sumitra S. (2008) Comparative Anatomy of Vertebrates. New Delhi,
10. William, K.P. (1998) Life- The Science of Biology, 5th edition, Sinauer Associates Inc.

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UNIVERSITY OF JAMMU
SYLLABI AND COURSE OF STUDY IN ZOOLOGY
UNDER CBCS AS PER NEP - 2020
(For the Examination to be held in Year 2026, 2027 & 2028)
(MINOR COURSE)

MINOR CORE COURSE NO.	:	UMIZOT805
MINOR CORE COURSE TITLE	:	FISH BIOLOGY AND DIVERSITY
CREDITS	:	04 {03 (Theory) + 01 (Practical)}
MAXIMUM MARKS	:	75
I) External (University Exam)	:	60
II) Internal Assessment	:	15
DURATION OF UNIVERSITY EXAM	:	03 Hours
MAXIMUM MARKS PRACTICALS	:	25
i) Continuous assessment	:	10
ii) Final examination	:	15

OBJECTIVES AND EXPECTED LEARNING OUTCOMES

This ichthyology course immerses students in the captivating world of fishes, covering their classification, morphology, and unique adaptations. It explores distinctive features, geographical distributions, and major fish groups such as Chondrichthyes, Actinopterygii, and Crossopterygii. From the intricacies of digestive, circulatory, and respiratory systems to the fascinating realms of electric organs and bioluminescence, students gain a comprehensive understanding of fish anatomy and physiology. The course also delves into adaptations, fish behavior, migration patterns, social interactions, and sensory perception. By the course's conclusion, students emerge as confident ichthyologists, equipped with knowledge of fish identification, evolution, and function to navigate the underwater world adeptly.

UNIT-I CLASSIFICATION, BODY FORM AND DIVERSITY

(10 HOURS)

- 1.1 Outline classification of fishes with special reference to distinctive features, geographical distribution, and typical examples of the sub-divisions: Chondrichthyes, Actinopterygii, Crossopterygii, and Dipnoi
- 1.2 Phylogenetic significance of Ostracoderms and Placoderms
- 1.3 Morphometric and Meristic studies in fishes as a taxonomic tool
- 1.4 Fin structure, types, modification and function, theories of origin of paired fins
- 1.5 Types of scales and development
- 1.6 Colouration in fishes



UNIT-II ANATOMY AND PHYSIOLOGY

(10 HOURS)

- 2.1 Food, feeding habit and alimentary canal diversification in fishes
- 2.2 Circulatory system: Heart and accessory pumps in fishes
- 2.3 Respiration in Fishes: Structure, modifications and functions of gills
- 2.4 Accessory Respiratory Organs in Fishes
- 2.5 Excretory organs and excretion in fishes
- 2.6 Osmoregulation in Fishes

UNIT-III ANATOMY AND PHYSIOLOGY-II

(10 HOURS)

- 3.1 Skeletal system - skull, splanchnocranium, jaw suspension and vertebral column.
- 3.2 Swim bladder: Structure, Types and functions
- 3.3 Reproductive organs and Accessory sex organs
- 3.4 Reproductive, Spawning, and Sexual Strategies in Fish
- 3.5 Electric organs: their structure and use in fishes
- 3.6 Bioluminescence in fishes and its significance

UNIT-IV HABITS, ADAPTATIONS AND SPECIFIC BEHAVIOUR IN FISHES (15 HOURS)

- 4.1 Hill stream, deep sea and Arctic and Antarctic fishes emphasizing on adaptation
- 4.2 Migratory Behavior in fishes
- 4.3 Shoaling in fishes
- 4.4 Nest building and parental Care
- 4.5 Poisonous fishes and their poisonous apparatus
- 4.6 Sensory Perception in Fishes
 - 4.6.1 Photoreception: Eye
 - 4.6.2 Acoustico-lateralis system
 - 4.6.3 Electroreception & Magnetoreception

PRACTICUM

(30 HOURS)

1. Study of Various Body Forms in Fishes
2. Fish Dissections:
 - a. Weberian ossicles of locally available fish
 - b. Dissection of Digestive System of locally available fish
 - c. Dissection of Efferent and Efferent Branchial System in *Wallago/Clarias*/ locally available fish
3. Identification of Indian Common Fish Faunal Resources: Cold water, warm water, brackish water, marine water, and ornamental fishes
4. Study of Various Modifications of Fins: Dorsal, Pectoral, Anal, and Caudal fins
5. Study of Morphometric and Meristic characteristic of Fishes
6. Preparation of Permanent Slides of Scales: Placoid, Cycloid, Ctenoid, Ganoid
7. Visit to Local Fish Seed Production Centre
8. Visit to Fish Aquarium at Bagh-e-Bahu Jammu
9. Use of fish identification key to identify local fishes of J&K



NOTE FOR PAPER SETTING

Examination Theory/Practical	Syllabus to be covered in Examination	Time allotted for Exam	% weightage (Marks)
Internal Theory Assessment	50%	1 Hr. and 30 Min.	15
External Theory End Semester	100%	3 Hours	60
Continuous Assessment	-	-	10 (Based on Daily Performance only)
Final Practical Examination	-	-	15

External End Semester Theory Examination will have two sections (A & B) {Total marks 60}

Section A: Four short answer questions representing all units/syllabi i.e., one question from each unit. Each question shall be of 3 marks.

Section B: Eight long answer questions (Four to be attempted) representing whole of the syllabi i.e., two questions from each unit. Each question shall be of 12 marks. Candidates are required to attempt four questions in all, selecting one from each unit.

Internal Assessment {Total marks 15}

Fifteen (15) marks for theory paper in a subject reserved for internal assessment shall have one long answer type question of 7 marks and four short answer type questions of 2 marks each.

RECOMMENDED READINGS

1. Gupta and Gupta. 2006. General and applied Ichthyology (Fish and Fisheries) S. Chand and Co, New Delhi
2. Jayaram, K. C. 2017. Fundamentals of fish taxonomy. Narendra Publishing House, Delhi.
3. Jhingran, V.G. 1975. Fish and Fisheries of India. Hindustan Publishing Co., Calcutta.
4. Khanna and Singh, 2003. A textbook of Fish Biology and Fisheries, Narendra Publishing House, India
5. Khanna, S. S. 2006. An Introduction to Fishes. Surjeet Publications, India
6. Kumar, A and Dubey, P. 2006. Fish Management and Aquatic Environment. Daya Publ. House, Delhi.
7. Lagler K.F., Bardach, J. E., Miller, R. R., Passino, D. R. M. 2012. Ichthyology, 2nd Ed. John Wiley & Sons, New York.
8. Lynwood, S. Smith. 2003. Introduction to the fish physiology. Narendra Publ. House, Delhi.
9. Mishra, 1962. Records of Indian Museum an aid to the identification of the common commercial fishes of India and Pakistan, Vol. 5 (Part I-IV)
10. Moyle PB and Joseph J. Cech Jr. 2004. Fishes: An Introduction to Ichthyology. 5 th Ed. Prentice Hall.



FYUGP (SEMESTER-VIII) (HONOURS) 2026-2028
TITLE-FISH BIOLOGY AND DIVERSITY
COURSE CODE- UMIZOT 805

11. Norman JR and Greenwood PH. 1975. A History of Fishes, Halsted Press.
12. R.R. Sticking. 2017. Aquaculture introductory (3rd edition), CAB International U.K.
13. Srivastava, C.B.L. 2019. A text book of Fishery Science and Indian Fisheries. Kitab Mahal. India
14. Yadav, B. N. 2016. Fish and Fisheries. Daya Publishing House, Delhi



UNIVERSITY OF JAMMU

SYLLABI AND COURSE OF STUDY IN ZOOLOGY

For the Examination to be held in Year 2026, 2027 & 2028

ZOOLOGY COURSE

UG SEMESTER VIII (HONOURS WITH RESEARCH)

UNDER NEP-2020



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University of Jammu

Syllabi of Zoology for FYUGP under CBCS as per NEP-2020

SEMESTER-VIII (HONOURS WITH RESEARCH)

(Examination to be held in 2026, 2027 & 2028)

Major Course

Course Code: **UMJZOT806**

Course Title: **BIOINSTRUMENTATION**

Credits: 04 {03(Theory) + 01(Practical)}

Total no. of lectures: Theory: 45 hours

Practical: 30 hours

Maximum Marks: 100

Theory: 75

Practical/Tutorial: 25

Minor Course

Course Code: **UMIZOT807**

Course Title: **TOOLS AND TECHNIQUES IN BIOLOGY**

Credits: 04 {03(Theory) + 01(Practical)}

Total no. of lectures: Theory: 45 hours

Practical: 30 hours

Maximum Marks: 100

Theory: 75

Practical/Tutorial: 25

Skill Enhancement Course

Course Code: **USEZOT808**

Course Title: **DISSERTATION**

Credits: 12

Maximum Marks: 300

UNIVERSITY OF JAMMU
SYLLABI AND COURSE OF STUDY IN ZOOLOGY
UNDER CBCS AS PER NEP - 2020
(For the Examination to be held in Year 2026, 2027 & 2028)
(MAJOR COURSE)

MAJOR CORE COURSE NO.	:	UMJZOT806
MAJOR CORE COURSE TITLE	:	BIOINSTRUMENTATION
CREDITS	:	04 {03 (Theory) + 01 (Practical)}
MAXIMUM MARKS	:	75
I) External (University Exam)	:	60
II) Internal Assessment	:	15
DURATION OF UNIVERSITY EXAM	:	03 Hours
MAXIMUM MARKS PRACTICALS	:	25
i) Continuous assessment	:	10
ii) Final examination	:	15

OBJECTIVES AND EXPECTED LEARNING OUTCOMES

This course aims to familiarize students with state-of-the-art instrumentation in biology, covering microscopy, histological techniques, separation techniques, advanced analytical methods, and radiation techniques. Students will gain a comprehensive understanding of microscopy principles, specimen preparation, and histological procedures. The course delves into separation techniques such as centrifugation, chromatography, and gel electrophoresis, providing hands-on experience. Advanced topics include the operation of pH meters, colorimetry, various spectroscopy techniques, DNA sequencing, and the principles of radiochemical techniques. By the end of the course, students will be well-equipped to apply these techniques in their research, ensuring a solid foundation in both theoretical knowledge and practical skills essential for biological research.

UNIT-I MICROSCOPY AND HISTOLOGICAL TECHNIQUES

(12 HOURS)

- 1.1 Microscopy-Principles, types and applications
 - 1.1.1 Light microscopy principles and its types: Bright Field, Dark Field and Phase contrast, Fluorescence microscopy, Confocal microscope
 - 1.1.2 Electron Microscope: TEM, SEM
 - 1.1.3 Scanning Tunnelling microscope
 - 1.1.4 Specimen preparation- Shadow casting, Freeze fracturing, Freeze etching
 - 1.1.5 Different fixation and staining techniques for EM
- 1.2 Histological Techniques
 - 1.2.1 Types of microtomes and microtomy.
 - 1.2.2 Preparation of temporary and permanent slides, whole mounts, smears, squashes and sections.

UNIT-II SEPARATION TECHNIQUES

(13 HOURS)

- 2.1 Centrifugation
 - 2.1.1 Basic principle and application
 - 2.1.2 Differential, density and ultracentrifugation
- 2.2 Chromatography: Basic principles, working and applications of Column chromatography, Ion-exchange chromatography, Affinity chromatography, Paper chromatography, Thin-layer chromatography (TLC), Gas chromatography, High-pressure liquid chromatography (HPLC)
- 2.3 Gel electrophoresis– PAGE, SDS and non SDS, 2D Gel electrophoresis, Isoelectric focusing, Density gradient gel electrophoresis, Capillary gel electrophoresis, Electrophoretic mobility shift assay (EMSA).
- 2.4 Southern Blotting, Western Blotting, Northern Blotting
- 2.5 Flow-cytometry

UNIT-III ADVANCED TECHNIQUES AND APPLICATIONS

(12 HOURS)

- 3.1 pH meter: Operation of pH electrodes, Principles and applications of Ion-selective and gas sensing electrodes, Oxygen electrodes.
- 3.2 Colorimetry: Principle and applications of colorimetry and spectrophotometry- Beer Lambert law
- 3.3 Spectroscopy: UV-Vis Spectroscopy, Fourier-Transform infrared spectroscopy (FTIR), Atomic absorption spectroscopy, Nuclear Magnetic resonance spectroscopy (NMR), Mass spectroscopy
- 3.4 DNA Sequencing Techniques (Sanger Sequencing and Maxam and Gilbert's chemical method) and Introduction to NGS.
- 3.5 Polymerase chain reaction: Principle and applications

UNIT-IV RADIATION TECHNIQUES IN BIOLOGY

(8 HOURS)

- 4.1 Basics of Radiochemical techniques
 - 4.1.1 Isotopes, Radioactive Decay, Units to Measure Radio Activity, Half Life
- 4.2 Carbon dating
- 4.3 Radioactive Labeling
- 4.4 Measurement of Radiation: Geiger Muller Counter, Scintillation Counter, Gamma Counter, Neutron Activation Analysis
- 4.5 Autoradiography – Method and applications.
- 4.6 Principle and applications of Biosensors.

PRACTICUM

(30 HOURS)

1. Study principle and working of Light microscope
2. Study of different components of of pH meter and measurement of pH of water samples.
3. To fix a tissue with Bouin's fixative and stain using haematoxylin – eosin stain for histochemical studies
4. Preparation of Blocks, section cutting using microtome, and stretching by wax methods and staining of vertebrate tissues by double staining methods

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**FYUGP (SEMESTER-VIII)(HONOURS WITH RESEARCH)
TITLE-BIOINSTRUMENTATION
COURSE CODE- UMJZOT806**

2026-2028

5. Application of spectrophotometer for validation of Beer –Lambert Law
6. Demonstration of PCR
7. Separation of proteins by SDS-PAGE
8. Separation of nucleic acids by Agarose gel electrophoresis
9. Separation of cell organelles by Differential centrifugation.
10. Separation of amino acids by paper and thin layer Chromatography

NOTE FOR PAPER SETTING

Examination Theory/Practical	Syllabus to be covered in Examination	Time allotted for Exam	% weightage (Marks)
Internal Theory Assessment	50%	1 Hr. and 30 Min.	15
External Theory End Semester	100%	3 Hours	60
Continuous assessment	-	-	10 (Based on Daily Performance only)
Final Practical examination	-	-	15

External End Semester Theory Examination will have two sections (A & B) {Total marks 60}

Section A: Four short answer questions representing all units/syllabi i.e., one question from each unit. Each question shall be of 3 marks.

Section B: Eight long answer questions (Four to be attempted) representing whole of the syllabi i.e., two questions from each unit. Each question shall be of 12 marks. Candidates are required to attempt four questions in all, selecting one from each unit.

Internal Assessment {Total marks 15}

Fifteen (15) marks for theory paper in a subject reserved for internal assessment shall have one long answer type question of 7 marks and four short answer type questions of 2 marks each.

RECOMMENDED READINGS

1. Alonso, A., and Arrondo, J.L.R.2006. *Advanced Techniques in Biophysics*.Springer,UK
2. Arora, M. P. 2007. *Biophysics*. Himalaya Publishing House, New Delhi
3. Daniel, M. 1989. Basic biophysics for biologists. Agro-Botanical Publishers, India.
4. Das, D. 1991. *Biophysics and Biophysical Chemistry*. Academic Publishers, Calcutta
5. Ewing, G.W. 1988. Instrumental methods of chemical analysis, McGraw Hill Book Company.
6. Ghatak K.L. 2011. *Techniques and Methods in Biology*. PHI Learning Pvt. Ltd. New Delhi
7. Gupta A. 2009. *Instrumentation and Bio-Analytical Techniques*. PragatiPrakashan, Meerut
8. Keith Wilson and John Walker. 2010. *Principles and techniques of Biochemistry and Molecular Biology*.7th Edition.

9. Narayanan, P. 2000. *Essentials of Biophysics*. New Age International (P) Ltd. Publishers, New Delhi
10. Roy, R.N. 1996. *A Textbook of Biophysics*. New Central Book Agency (P) Ltd. Calcutta
11. Sandhu, G.S. 1990. *Research Techniques in Biological Sciences*. Anmol Publications, New Delhi
12. Skoog, A., Douglas, J. and Leary, J.J. 1992. *Principles of Instrumental Analysis*. Sanders Golden Sunberst Series, Philadelphia.
13. Srivastava, P.K. 2006. *Elementary Biophysics. An Introduction*. Narosa Publishing House, New Delhi
14. Veerakumari, L. 2006. *Bioinstrumentation*. MJP Publishers, Chennai.
15. Wilson and Walker. 2000. *Practical biochemistry - principles and techniques*. Cambridge University Press.

UNIVERSITY OF JAMMU
SYLLABI AND COURSE OF STUDY IN ZOOLOGY
UNDER CBCS AS PER NEP - 2020
(For the Examination to be held in Year 2026, 2027 & 2028)
(MINOR COURSE)

MINOR CORE COURSE NO.	:	UMIZOT807
MINOR CORE COURSE TITLE	:	TOOLS AND TECHNIQUES IN BIOLOGY
CREDITS	:	04 {03 (Theory) + 01 (Practical)}
MAXIMUM MARKS	:	75
I) External (University Exam)	:	60
II) Internal Assessment	:	15
DURATION OF UNIVERSITY EXAM	:	03 Hours
MAXIMUM MARKS PRACTICALS	:	25
i) Continuous assessment	:	10
ii) Final examination	:	15

OBJECTIVES AND EXPECTED LEARNING OUTCOMES

This course aims to familiarize students with state-of-the-art instrumentation in biology, covering microscopy, histological techniques, separation techniques, advanced analytical methods, and radiation techniques. Students will gain a comprehensive understanding of microscopy principles, specimen preparation, and histological procedures. The course delves into separation techniques such as centrifugation, chromatography, and gel electrophoresis, providing hands-on experience. Advanced topics include the operation of pH meters, colorimetry, various spectroscopy techniques, DNA sequencing, and the principles of radiochemical techniques. By the end of the course, students will be well-equipped to apply these techniques in their research, ensuring a solid foundation in both theoretical knowledge and practical skills essential for biological research.

UNIT-I MICROSCOPY AND HISTOLOGICAL TECHNIQUES (12 HOURS)

- 1.1 Microscopy-Principles, types and applications
 - 1.1.1 Light microscopy principles and its types: Bright Field, Dark Field, Phase contrast, Fluorescence microscopy, Confocal microscope
 - 1.1.2 Electron Microscope: TEM, SEM
 - 1.1.3 Scanning Tunnelling microscope
 - 1.1.4 Specimen preparation- Shadow casting, Freeze fracturing, Freeze etching
 - 1.1.5 Different fixation and staining techniques for EM
- 1.2 Histological Techniques
 - 1.2.1 Types of microtomes and microtomy.
 - 1.2.2 Preparation of temporary and permanent slides, whole mounts, smears, squashes and sections.

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UNIT-II SEPARATION TECHNIQUES

(13 HOURS)

2.1 Centrifugation

2.1.1 Basic principle and application

2.1.2 Differential, density and ultracentrifugation

2.2 Chromatography: Basic principles, working and applications of Column chromatography, Ion-exchange chromatography, Affinity chromatography, Paper chromatography, Thin-layer chromatography (TLC), Gas chromatography, High-pressure liquid chromatography (HPLC)

2.3 Gel electrophoresis– PAGE, SDS and non SDS, 2D Gel electrophoresis, Isoelectric focusing, Density gradient gel electrophoresis, Capillary gel electrophoresis, Electrophoretic mobility shift assay (EMSA).

2.4 Southern Blotting, Western Blotting, Northern Blotting

2.5 Flow-cytometry

UNIT-III ADVANCED TECHNIQUES AND APPLICATIONS

(12 HOURS)

3.1 pH meter: Operation of pH electrodes, Principles and applications of Ion-selective and gas sensing electrodes, Oxygen electrodes.

3.2 Colorimetry: Principle and applications of colorimetry and spectrophotometry- Beer Lambert law

3.3 Spectroscopy: UV-Vis Spectroscopy, Fourier-Transform infrared spectroscopy (FTIR), Atomic absorption spectroscopy, Nuclear Magnetic resonance spectroscopy (NMR), Mass spectroscopy

3.4 DNA Sequencing Techniques (Sanger Sequencing and Maxam and Gilbert's chemical method) and Introduction to NGS.

3.5 Polymerase chain reaction: Principle and applications

UNIT-IV RADIATION TECHNIQUES IN BIOLOGY

(8 HOURS)

4.1 Basics of Radiochemical techniques

4.1.1 Isotopes, Radioactive Decay, Units to Measure Radio Activity, Half Life

4.2 Carbon dating

4.3 Radioactive Labeling

4.4 Measurement of Radiation: Geiger Muller Counter, Scintillation Counter, Gamma Counter, Neutron Activation Analysis

4.5 Autoradiography – Method and applications.

4.6 Principle and applications of Biosensors.

PRACTICUM

(30 HOURS)

1. Study principle and working of Light microscope

2. Study of different components of pH meter and measurement of pH of water samples.

3. To fix a tissue with Bouin's fixative and stain using haematoxylin – eosin stain for histochemical studies

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4. Preparation of Blocks, section cutting using microtome, and stretching by wax methods and staining of vertebrate tissues by double staining methods
5. Application of spectrophotometer for validation of Beer –Lambert Law
6. Demonstration of PCR
7. Separation of proteins by SDS-PAGE
8. Separation of nucleic acids by Agarose gel electrophoresis
9. Separation of cell organelles by Differential centrifugation.
10. Separation of amino acids by paper and thin layer Chromatography

NOTE FOR PAPER SETTING

Examination Theory/Practical	Syllabus to be covered in Examination	Time allotted for Exam	% weightage (Marks)
Internal Theory Assessment	50%	1 Hr. and 30 Min.	15
External Theory End Semester	100%	3 Hours	60
Continuous Assessment	-	-	10 (Based on Daily Performance only)
Final Practical Examination	-	-	15

External End Semester Theory Examination will have two sections (A & B) {Total marks 60}

Section A: Four short answer questions representing all units/syllabi i.e., one question from each unit. Each question shall be of 3 marks.

Section B: Eight long answer questions (Four to be attempted) representing whole of the syllabi i.e., two questions from each unit. Each question shall be of 12 marks. Candidates are required to attempt four questions in all, selecting one from each unit.

Internal Assessment {Total marks 15}

Fifteen (15) marks for theory paper in a subject reserved for internal assessment shall have one long answer type question of 7 marks and four short answer type questions of 2 marks each.

RECOMMENDED READINGS.

1. Alonso, A., and Arrondo, J.L.R.2006. *Advanced Techniques in Biophysics*.Springer,UK
2. Arora, M. P. 2007. *Biophysics*. Himalaya Publishing House, New Delhi
3. Daniel, M. 1989. Basic biophysics for biologists. Agro-Botanical Publishers, India.
4. Das, D. 1991. *Biophysics and Biophysical Chemistry*. Academic Publishers, Calcutta
5. Ewing, G.W. 1988. Instrumental methods of chemical analysis, McGraw Hill Book Company.
6. Ghatak K.L. 2011.*Techniques and Methods in Biology*. PHI Learning Pvt. Ltd. New Delhi

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7. Gupta A. 2009. *Instrumentation and Bio-Analytical Techniques*. PragatiPrakashan, Meerut
8. Keith Wilson and John Walker. 2010. *Principles and techniques of Biochemistry and Molecular Biology*. 7th Edition.
9. Narayanan, P. 2000. *Essentials of Biophysics*. New Age International (P) Ltd. Publishers, New Delhi
10. Roy, R.N. 1996. *A Textbook of Biophysics*. New Central Book Agency (P) Ltd. Calcutta
11. Sandhu, G.S. 1990. *Research Techniques in Biological Sciences*. Anmol Publications, New Delhi
12. Skoog, A., Douglas, J. and Leary, J.J. 1992. *Principles of Instrumental Analysis*. Sanders Golden Sunberst Series, Philadelphia.
13. Srivastava, P.K. 2006. *Elementary Biophysics. An Introduction*. Narosa Publishing House, New Delhi
14. Veerakumari, L. 2006. *Bioinstrumentation*. MJP Publishers, Chennai.
15. Wilson and Walker. 2000. *Practical biochemistry - principles and techniques*. Cambridge University Press.

UNIVERSITY OF JAMMU
SYLLABI AND COURSE OF STUDY IN ZOOLOGY
UNDER CBCS AS PER NEP - 2020
(For the Examination to be held in Year 2026, 2027 & 2028)
(SKILL ENHANCEMENT COURSE)

CORE COURSE NO.	:	USEZOT-808
CORE COURSE TITLE	:	DISSERTATION
CREDITS	:	12 {8 (Dissertation) + 4 (Viva)}
MAXIMUM MARKS	:	300
I) Dissertation	:	200
II) Presentation of PPT and viva	:	100

Objectives and Expected Learning Outcomes

The primary objective of this project work course is to facilitate the application of theoretical knowledge in solving real-world problems, fostering research competencies among undergraduate students. Through hands-on projects, students will develop critical thinking skills, and proficiency in data analysis. The course aims to cultivate a problem-solving mindset, enhance self-directed learning, and provide a platform for the acquisition of advanced knowledge through project-based study. Upon completion of the project work course, students will gain practical experience in applying academic concepts to real-life situations. They will develop strong research competencies, including data collection and analysis, literature review skills, and will be able to draw meaningful conclusions. Additionally, students will hone their communication, teamwork, and time management skills, preparing them for the challenges of their future careers or advanced academic pursuits. Overall, the course aims to equip students with the necessary skills and knowledge to thrive in professional and research-oriented environments.

Scheme of Research Project and Dissertation

Allotment of Supervisor:

Each student shall carry out a project work in one of the broad areas of Zoology in the semester VIII under the supervision of the faculty of the department.

Research Work and Dissertation Writing:

1. After the approval of the proposal, the student will carry out the proposed research (field/lab. work) and post-completion of the research work, students will write the dissertation. During the field/lab. Work as well as during the compilation of the dissertation the student will work under continuous guidance of the supervisor who will maintain the regular attendance of the student.
2. Student will submit 2 hard copies of the final dissertation in the department along with a soft copy of the same.

Format for dissertation is given below:

The dissertation should be presented chapter wise. Each chapter will have a precise title as given below. A chapter can be subdivided into sections, and sub-section so as to present the content discretely and with due emphasis.

Abstract

Content Page

List of Figures

List of Tables

Acknowledgement

List of Abbreviations

Chapter 1: Introduction:

It shall justify and highlight the problem posed, define the topic and explain the aim and scope of the work presented in the dissertation. This chapter also include objective of the research work. It may also highlight the significant contributions from the investigation.

Chapter 2: Review of Literature:

This Chapter presents a critical appraisal of the previous work published in the literature pertaining to the topic of the investigation.

Chapter 3: Material and Methods:

This chapter deals with a detail methodology/technique/theory by which researcher used to carry out the research work.

Chapter 4: Results and Discussion:

This chapter includes a thorough evaluation of the investigation carried out and brings out the contributions from the study. The discussion shall logically lead to inferences and conclusions as well as scope for possible further future work.

Chapter 5: Summary and Conclusion

A brief report of the work carried out shall form the first part of the Chapter. Conclusions derived from the logical analysis presented in the results and discussions chapter shall be presented and clearly enumerated, each point stated separately. Scope for future work should be stated lucidly in the last part of this chapter.

Chapter 6: References/Bibliography:

The candidates shall follow the style for references as mentioned below.

For journal:

Loizides, M., Georgiou, A.N., Somarakis, S., Witten, P.E. and Koumoundouros, G., 2014. A new type of lordosis and vertebral body compression in G ilthead sea bream, *S parus aurata* L.: aetiology, anatomy and consequences for survival. *Journal of Fish Diseases*, 37(11), pp.949-957.

TYPE -SETTING, TEXT PROCESSING AND PRINTING

1. The text shall be printed employing using a standard text processor. The standard font shall be Times New Roman of 12 pts with 1.5 line spacing.
2. **Binding** Spiral or hard Binding
3. **Front Covers:**The front covers shall contain the following details:
 - a. Full title of dissertation in 6 mm/22 point's size font properly centered and positioned at the top.
 - b. Full name of the candidate in 4.5 mm 15 point's size font properly centered at the middle of the page.
 - c. 40 mm wide replica of the College and University emblems followed by the name of department, name of the College, name of the University and the year of submission, each in a separate line and properly centered and located at the bottom of page.
4. **Title Sheet:** This shall be the first printed page of the thesis and shall contain the submission statement: the dissertation submitted in partial fulfilment of the requirements of the B.Sc. (Honours) Zoology, the name, Registration No. and University Roll No. of the candidate, name(s) of the Supervisor, Department, College, University and year of submission.
5. **A Declaration of Academic Honesty and Integrity by Candidate:**A declaration of Academic honesty and integrity is required to be included along with every dissertation. The format of this declaration is given in **Annexure-I** attached.
6. **Certificate from Supervisor (Annexure-II):**
7. **Abstract:**The 500 word (maximum) abstract shall highlight the important features of the dissertation.

Evaluation of the dissertation:

1. The project report/dissertation shall be evaluated by the external expert from other University/Colleges to be nominated by the Principal out of the panel supplied by the College Research Committee (CRC) in accordance with Guidelines for FYUGP issued by the University of Jammu.
2. The students shall be declared pass in the research project course if she/he secures minimum 40% marks (Dissertation and viva).

ANNEXURE-I

CERTIFICATE

The work embodied in this dissertation entitled "....."
....."
....." (write the title in capital letters) has been
carried out by me under the supervision of
..... (give the name of the Guide).

This work is original and has not been submitted by me for the award of any other degree of University of Jammu or any other University. I also declare that no chapter of this manuscript in whole or in part is lifted and incorporated.

.....
.....
(Signature and Name of the Candidate)

Date :

Place :

ANNEXURE-II

CERTIFICATE OF DISSERTATION GUIDE/SUPERVISOR

I certify that the candidate /Mr./Ms./Mrs has
planned and conducted the research study entitled “.....
.....” under my guidance and supervision and that the report submitted
herewith is a genuine, original, and bonafide work done by the candidate in
..... (Place) from..... to (Dates).

.....
.....

(Signature and Name of the Supervisor)

Date :

Place :

.....
.....

Name, Signature of HoD